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CANADA

REPORT

of the

ROYAL COMMISSION

on

FARM MACHINERY

1971

Dr. Clarence L. Barber
Commissioner

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CANADA

Royal Commission on Farm Machinery

TO HIS EXCELLENCY

THE GOVERNOR GENERAL IN COUNCIL

I, the Commissioner, appointed by Order in Council P.C. 1966-978 dated 26th May, 1966, to inquire into the costs of machinery and repair parts: Beg to submit to Your Excellency the following Final Report.

Clarence L Barber

Clarence L. Barber

Commissioner

March, 1971

ORDER IN COUNCIL

P.C. 1966-978

Certified to be a true copy of a Minute of a Meeting of the Committee of the Privy Council, approved by His Excellency the Governor General on the 26th May, 1966.

The Committee of the Privy Council, on the recommendation of the Right Honourable Lester Bowles Pearson the Prime Minister, advise that Clarence Lyle Barber of the City of Winnipeg, Province of Manitoba, be appointed a Commissioner under Part I of the Inquiries Act to inquire into the costs of farm machinery and repair parts and, in particular, without limiting the generality of the foregoing, to consider and report upon

(1) the factors affecting the price to the user of agricultural machinery and equipment and parts in Canada including full reference to the impact of financing, distribution and servicing costs on the total price of the user;

(2) the costs to the user of agricultural machinery in Canada as compared with the costs of similar equipment to users in other countries, both in absolute terms and in relation to total costs;

(3) the present and prospective competitive position of the Canadian agricultural machinery industry in Canadian and in export markets as compared with agricultural machinery industries in other countries, including an examination of research and development activity and its relationship to the establishment of new facilities in Canada;

(4) the historical and present relationship between the price and the productivity of agricultural machinery;

(5) measures that would contribute to the expansion of efficient production of agricultural machinery, the attainment of technological advances, the improvement of distribution, financing and servicing facilities and the enhancement of the industry's competitive position so that Canadian farmers would be ensured most favourable prices for, and availability of, machinery and parts.

The Committee further advise

(a) that the Commissioner be authorized to exercise all the powers set out in section 11 of the Inquiries Act;

(b) that the Commissioner be authorized to engage the services of counsel, technical advisers, experts and staff as may be required, at rates of remuneration, including transportation and living expenses as may be approved by the Treasury Board;

(c) that the Commissioner adopt such procedure and methods as he may from time to time deem expedient for the proper conduct of the inquiry and sit at such times and at such places in Canada as he may decide from time to time;

(d) that the Commissioner be assisted to the fullest extent by government departments and agencies; and

(e) that the Commissioner report to the Governor in Council and file with the Dominion Archivist the papers and records of the inquiry as soon as reasonably may be after conclusion of the inquiry.

R. G. Robertson
Clerk of the Privy Council

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PART III – COMPETITIVE POSITION OF THE INDUSTRY IN THE NORTH AMERICAN AND WORLD MARKET

ACKNOWLEDGEMENTS

During the four years that this Commission has been in existence many people have been instrumental in helping it to achieve its goals. To all of them, whether their names are listed here or not, I express my very deep thanks. Without them it would just not have been possible to explore the industry in the depth and detail which I feel has been accomplished.

Among the first whose assistance should be acknowledged are the farm machinery companies themselves. Not unnaturally, they viewed with some misgivings the appointment of a Royal Commission to investigate their activities. More than any other industry, the farm machinery manufacturers have been subject to government investigations in the past. These inquiries are an expensive business for them, and their mixed feelings are understandable. Nevertheless, they co-operated fully in the investigation as it progressed. Without that co-operation the Commission could not have undertaken its extensive program of research.

Of equal importance to the Commission's work were the contributions of farm organizations, provincial governments and individuals, outlining the problems in the area of farm machinery as they saw them. Their presentations and the briefs that supported them are listed in Appendix C to this Report.

The Commission is also indebted to the personnel of various manufacturing organizations and government research and testing stations which were visited in 1967. In particular, the valuable insight into problems connected with research and testing gained from visits to the National Institute of Agricultural Engineering in Silsoe, England, the Swedish Test Institute at Uppsala, and the Völkenrode Institute at Brunswick, Germany, should be mentioned. The many contacts made on the Commission's trip to Europe in 1967 would not have been possible without the generous help of the Canadian Missions in the countries concerned. To the staffs overseas and to the officials in the Departments of External Affairs and Industry, Trade and Commerce in Ottawa who helped arrange our trip, the Commission's thanks are extended.

In Appendix D of this Report are noted the names of those who contributed to the Commission's work as staff members or as research consultants and study authors. The contribution made by each of these is gratefully acknowledged. Of the many people who made valuable contributions, several deserve special mention. Of particular importance were the contributions of Dr. David Schwartzman of the New School for Social Research in New York City. His special background in industrial organization and the advice he provided in this field greatly strengthened the Report's analysis in this area. The important contributions made by Dr. G. F. Donaldson of Wye College, the University of London, must also be emphasized. Not only did he provide three significant studies for the Commission but he was also responsible along with Dr. J. P. McInerney of the University of Manchester for

providing an initial draft of Chapters 21 to 26 of this report. Mr. D. Martinusen who was responsible for carrying through the financial analysis required for the Commission's Report also deserves particular mention.

In all its work the Commission benefited from the energy, persistence and initiative of its Director of Research, Mr. Neil MacDonald. Directing the research required for this Commission's Report was not an easy task, requiring as it did some knowledge of many different areas. The significant contributions to our knowledge of the industry made by this Report, the Special Report and the numerous studies published by the Commission are due in no small measure to Mr. MacDonald.

Finally, the Commission was fortunate in its small but efficient administrative staff who kept its work running smoothly. In particular, I would like to single out for mention Miss Lois Culpan, the Commission's Administrative Secretary, Mrs. Eva Dawe and Mrs. Alberta Lamb, who were editorial assistants for the reports and studies of the Commission, and Mrs. Olive Calder and Miss Marni Linton who carried out many specialized tasks in the preparation of manuscripts. The Commission is grateful to Mrs. Ina Deruchie for graphic work and to Mrs. Theresa Hodgins who did much of the editing. The Commission's appreciation is also extended to Mr. Don Hanright who served as editorial adviser, and to Mr. R. H. McKercher, the Commission's counsel.

PART I

INTRODUCTION AND PERSPECTIVE

Chapter 1

INTRODUCTION

When I was first appointed as a Commissioner I was often asked, "Why was this Commission appointed?" At the time I was not in a position to give any clear answer. Some time later, after receiving the views of the farmers, the dealers and the machinery companies in their submissions to the Commission and during the public hearings, the reason why the Commission was established became much clearer. It became evident to me that changes in farm machinery technology were exerting far-reaching effects on the whole rural scene. More than any other single cause, it has been improvements in farm machinery that have led to the large outflow of labour and population from agriculture since 1945. Again, it has been improvements in farm machinery technology that have resulted in the trend to larger farming units. Along with better transportation, these machinery improvements have also helped cause a decline in the number of farm machinery dealers and a concentration of machinery sales and service in larger trading centres. With farming much more highly mechanized, the farmer has also found himself more vulnerable to the effects of machine breakdown during his busy seasons – in particular during seeding operations in the spring, during the haying season, and at harvest time. All of these changes have created a sense of uneasiness among many farm people and a feeling that farm machinery was in some way one of the sources of their difficulties. Thus, there was a genuine need for a thorough examination of developments that were exerting such revolutionary effects on farming operations. It was undoubtedly a recognition of this that led to the Commission's appointment.

This Report is divided into five major parts. Part I provides a brief summary of the Report's principal findings along with an index of its recommendations and summarizes in a straightforward fashion and without comment the various views expressed in the submissions received by the Commission or made orally during the Commission's public hearings. Part II considers the market structure and competitive behaviour of the industry that supplies farm machinery to Canadian farmers. It examines the wholesale and retail distribution and finance of farm machinery as well as its manufacture. Part III examines a number of questions affecting the competitive position of the industry in the world market. Part IV reviews the changes and adjustments that changing farm machinery technology has imposed on

Canadian agriculture and, in the light of prospective further changes, considers how the Canadian farmer can be helped to adjust to these changes. Finally, Part V considers a number of special problems that do not fit readily under other headings. These include the problems of repair parts, parts standardization, warranty, postwar changes in prices and costs, and special problems involving farm machinery dealers. The Report concludes with four appendices, two of which relate to the body of this Report. One provides a selection of statistics related to farm machinery and the other presents some information on economies of scale in different types of Canadian farming.

For the purposes of this Report, farm machinery has been definted to include all those machines and implements included in the agricultural implements industry as defined for statistical purposes in the Standard Industrial Classification (S.I.C. 311). As such it includes farm tractors but excludes garden tractors, truck tractors for highway purposes, and tractors used primarily for industrial or construction purposes. Hand tools are also excluded. Some statistical series related to farm machinery, such as the price index of machinery to the farmer, include farm trucks. However, it was decided to exclude trucks from the scope of this Report because their problems are more like those of the automobile industry which has already been subject to one Royal Commission inquiry.[1]

The postwar period has witnessed very significant changes in the structure and organization of the industry that supplies machinery to the farmer. At the end of the 1930s, the industry was dominated by a small number of firms that controlled both the production and distribution of farm machinery. Although the growing sophistication and complexity of machinery was gradually to make the existing distribution system untenable, the industry at the time assumed the major responsibility for supplying repair parts and service. At that time trade-ins were not an important problem, and implements were for the most part of a type that farmers could service themselves if the necessary repair parts were available. Further, before the advent of the combine the timing of harvest operations was less critical, and farmers generally were less aware of the importance of timely seeding, tillage and haying operations. Thus service and the supply of repair parts could be handled through the company's regional branch houses. At the manufacturing level the Canadian industry was mainly oriented to production for the Canadian market or for export to overseas markets. Although the U.S. tariff had been taken off all farm machinery in 1913, the Canadian tariff was not removed until 1944.

In the 25 years that have elapsed since the end of the Second World War, the industry has been transformed into one with a continent-wide, and to some degree worldwide, focus. Although many of the major firms are the same, they have increased very greatly in size. Massey-Harris Company Limited had annual sales of $21 million in 1939. By 1969 its successor company, Massey-Ferguson Limited,

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[1] *Report of the Royal Commission on the Automobile Industry* (Ottawa: Queen's Printer, April 1961).

had worldwide sales of Canadian $1,043 million, of which only a little over 8 per cent were in Canada. Almost all the Canadian manufacturing plants now specialize in the production of a few farm machines which are sold throughout North America. As a result, about two-thirds of the farm machinery manufactured in Canada is exported. And 70 per cent of the machinery sold to Canadian farmers is imported. While most of Canada's imports come from the United States, in recent years there has been an increasing flow of imports from Western Europe, especially of tractors, and to a lesser extent, combines.

Another development has been a greatly increased emphasis on research and development expenditures in the industry. Although farmers still contribute many original ideas, increasingly it is industry expenditures that turn these ideas into effective working machines. Massey-Harris was spending about $500,000 on research and development (R&D) in the late thirties. In 1967 Deere & Company reported an R&D expenditure of $46 million. As a result of this level of expenditure and developments in related industries, farm machinery has increased very greatly in sophistication and complexity. The addition of hydraulics, hydrostatic transmissions, diesel engines, and complex sensing mechanisms has not only made farm machinery much more powerful and productive, but has also added to the skill levels required for its operation and for its effective care and maintenance.

Along with this growing sophistication has come an increase in the size of many farm machines. The average size of farm tractor sold has increased from 19.3 HP in 1945 to 62.6 HP for all Canada by 1968, and to 83.2 HP on the Prairies. Many of the tractors sold in the latter area today are over 100 HP in size. And there have been parallel increases in the size of the seeding and cultivating equipment used with them. Combines also have increased very significantly in size.

Accompanying this growth in size of the tractor and other farm machinery has been a consolidation and amalgamation of many farms into larger operating units. Thus, while the total market for farm machinery has continued to increase in terms of dollar volume, the number of units of each machine sold has declined. The number of farm tractors manufactured in North America in 1969 was less than half the number produced in 1951. Unlike the automotive and many other industries whose unit volume increases year by year, the farm machinery industry has faced a declining unit volume. It has been losing rather than gaining economies of scale.

Faced with rising labour costs and declining volume, the industry has recently begun to move towards a more international organization of its manufacturing operations. For example, in the early sixties Ford Motor Company rationalized its tractor manufacturing operations on a worldwide basis, producing each major component in one location only – mainly Basildon, England, and Antwerp, Belgium -- and assembling in three different locations, Basildon, Antwerp, and Detroit. In this way it was able to obtain a larger volume and at the same time take advantage of the lower manufacturing costs that prevail in Europe.

These various forces have also produced changes in the other major producing firms. White Motor Company now operates the formerly separate firms of Cockshutt, Oliver, and Minneapolis-Moline, having acquired them at distress prices. It has closed some plants and consolidated output for all three firms in others. Some new firms have appeared. New Holland, now an important producer of haying and harvesting equipment, was just starting to produce farm machinery in 1939. Canadian Co-operative Implements Limited (C.C.I.L.) formed during the war years, has gradually expanded its manufacturing and distribution operations and now occupies a significant place in the Prairie market. Versatile Manufacturing Ltd. in Winnipeg has grown from a small company producing grain augers, sprayers, and drawbars, to a firm with annual sales of $33.8 million in 1969 and with an important production of swathers, combines, and large four-wheel-drive tractors. Generally, however, the industry is still dominated by firms that are among North America's industrial giants.

Until about 1945 the Canadian industry sold its products through local agents who had very little in the way of a stock of repair parts or service facilities. With the growing complexity of farm machinery and the farmer's increasing stress on the need for prompt service, this system was proving unsatisfactory. For this reason, around the end of the Second World War, the industry changed to a system of franchised dealers. These dealers are independent businessmen who purchase machines and repair parts from the companies, maintain service facilities, and provide sales and service to the farmer. In the period of buoyant sales immediately after 1945, these dealers were able to finance their operations with little or no help from the companies. However, when the backlog of demand that had developed during the war and the depression was pretty well satisfied, sales slumped and the companies found it difficult to get their dealers to keep what they regarded as an adequate stock of machines. For this reason, they introduced a plan which called for the interest-free "floor-planning" of new machines. Under this plan the dealer would contract to buy new machines but would obtain them on an interest-free basis for up to 12 months for tractors and up to 23 months for most other machinery.

For the major companies this plan had the advantage of keeping an adequate stock of machines on view at the dealer's place of business. It also made it easier to persuade dealers to contract for machines that did not have to be sold immediately and for which the ultimate payment date was comfortably in the future. The plan had some disadvantages, too. Sales that in the short run are completely financed by the company contain a substantial element of risk. In periods of depressed sales, dealers may go bankrupt, leaving a company to repossess a dealer's unsold inventory. The scheme has also given the farm machinery industry an unusual asset structure. In recent years Deere & Company has had total assets equal in amount to 133 per cent of its annual sales. Accounts receivable alone have amounted to 75 per cent of annual sales. In contrast, their net fixed assets have been only some 22 per cent of annual sales and less than 17 per cent of their total assets. In the end, of course, the heavy carrying costs associated with the large inventory carried by dealers must be paid by the farmer.

At the distribution level significant structural changes have been taking place. The major manufacturers all maintain their own wholesale branch-house distribution network to support their sales and service. But the number of branches has been greatly reduced in recent years. The major companies have recently been closing many of their smaller dealerships, and concentrating on sales by the larger dealers who operate out of major trading centres. For four major companies, the number of dealer franchises in Canada declined 45 per cent between 1962 and 1969. Some of the dealers whose franchises were cancelled have stayed in business by handling the products of smaller and more specialized manufacturers. Nevertheless, it is clear that a major structural change has been occurring. Since the cost of supervising and supporting dealers has become a substantial component in the companies' branch-house distribution costs, this change undoubtedly reflects pressure on the companies to reduce their costs. The change is also likely to improve the quality of service to the farmers. One of the Commission's surveys has shown that the small dealer accounts for a disproportionate share of farmers' complaints about slow or poor-quality service.

During the postwar period almost all the major companies began to finance farm machinery sales at the retail level, and they set up finance subsidiaries to help support this activity. Not only has finance been used as a competitive device in general, but by offering interest-free financing on "out of season" sales it has also been used as a method of encouraging the farmer to buy ahead of the normal season of use. More recently, interest-free "in season" deals have been offered which have been little more than disguised price cuts.

At the retail of dealer level there has been keen competition for the farmer's business, and dealer operating margins have declined over the postwar period. There is also some evidence that dealer efficiency increases over a moderate range as dealer size increases.

Because the production and sale of farm machinery in Canada is just one part of a continent-wide, and to some degree worldwide, activity, it has been necessary to examine many of the industry's problems from an equally broad point of view. Thus, as was made clear in the *Special Report on Prices of Tractors and Combines in Canada and Other Countries* released January 1970, the prices of tractors and other farm machines in Canada depend to a major degree on the way in which the leading companies "source" the machinery sold in Canada and on how it is priced for transfer between divisions of the same company. Many of these decisions are made outside Canada.

Similarly, the profits reported as being earned in Canada require very careful interpretation, because they depend heavily on the prices at which machines are being transferred from one division to another of the same international company. With such transfer prices involved in a very large part of Canadian imports and exports of farm machinery, it is clear that profits reported within Canada have a somewhat artificial character. For example, in 1966, four major companies

reported a profit before tax in Canada of about \$35 million. However, if all of the companies had used the least favourable of the transfer prices on imports and exports used by any one of these firms, reported profits would have been only \$25 million. If they had all used the most favourable (to Canada) of the transfer prices used by any firm, the profits would have been \$47 million.

Evidence gathered by the Commission indicates that a very substantial share of the profits earned by the international farm machinery companies on their sales of equipment to Canadian farmers are earned outside Canada. For example, in 1966 it was estimated that a number of major firms in the industry earned a total profit of \$54 million on sales of \$310 million in Canada. Of this total, \$25 million was reported as earned in Canada and \$29 million as earned in the United States or other countries. Because of the difficulties of gathering data outside Canada, profits on this basis were developed by the Commission for only the one year.

In general, the profits earned by the major international farm machinery companies during the postwar period have been moderate compared with those earned by many other industries. They have been at a substantially lower rate than those earned by the industry in the twenties or thirties. During the past decade, the profits reported in Canada increased rapidly during the period of rising sales up to 1966, but have since fallen sharply. In 1969 the companies reporting to the Commission recorded a net profit (after taxes) of only \$.6 million on sales of \$491 million. Three years earlier in 1966 the same companies had reported an after-tax profit in Canada of \$30 million on sales of \$569 million. These profits include those earned on export as well as domestic sales, and are strongly affected by transfer prices as described above.

Although profits on the average have been moderate, the industry is characterized by a high degree of concentration in the sense that a small number of companies account for a large proportion of all sales. It is also an industry that has formidable barriers to the entry of new firms. Entry barriers exist on both the demand and cost side. On the demand side, the highly seasonal and erratic year-to-year fluctuations in sales and the comparatively slow longer-term growth in demand have favoured the large well-established firm. On the cost side, the importance of economies of scale has had a similar effect. The need for a well-organized distribution and repair parts service is also a major entry barrier.

Despite these barriers, new firms have entered the industry and over the past decade the share of the market enjoyed by the three largest firms has declined appreciably for almost all major product lines. For all farm machinery the market share of the three largest firms fell from 50 per cent in 1957 to 42 per cent in 1967. This evidence of declining market shares for major companies in spite of significant barriers to entry and moderate profits is consistent with the picture of an industry that has followed a policy of pricing its products high in relation to manufacturing costs. The high prices have allowed smaller firms with lower volume and higher unit

costs to survive, and in some cases even increase their market shares. Some of the smaller firms have been reorganized after suffering serious losses with a major writing-down in asset values. The high prices have also attracted new entrants to the industry. For tractors, the new entrants have included British firms such as British Leyland Motors and David Brown, as well as a Canadian firm, Versatile. For combines, they have included European models such as New Holland's Clayson machine and Ford's Claas-made combine as well as Versatile's own model. For other products, too, such as swathers, diskers, and other tillage equipment, the major companies' policy of pricing high in relation to manufacturing cost appears to have been a factor in attracting new entrants. To the extent that the new entrants have smaller volume and higher costs than the major firms, their entry does not bring the price down, but simply divides the market among a larger number of firms.

That a policy of pricing high in relation to manufacturing costs has not resulted in higher rates of profit is due in very considerable measure to the large distribution assets the industry has accumulated – a direct result of its practice of interest-free floor-planning of dealer inventory. Because the Canadian industry is just one small part of a continental, and to some degree worldwide, one, it is not easy to devise policies for adoption by the Canadian government that will have substantial effects on the industry's structure. The Commission's major proposal designed to affect industry structure is for an eventual ban on the practice of interest-free floor-planning. The first step suggested is for a limit on the period for which interest-free credit could be granted – six months on tractors, and 12 months for all other machines. In time, this restriction should lead to less accumulation of inventory in the hands of dealers and a significant over-all reduction in distribution costs. The recommendation is described in more detail in Chapter 11.

The industry has been accused here of pricing high in relation to cost. This is, of course, a relative matter. Nevertheless, it is a difference that can have a substantial effect on both unit costs and prices in the industry. This is especially so where unit costs increase significantly as the volume of output declines, as is true for tractors and combines and may well be true for other farm machines. In these circumstances, if the leading firms in the industry price high in relation to unit costs, the attractive gross margin created in this way will induce other firms to enter the industry or allow existing small firms to survive. The end result is one where the major firms end up with a smaller sales volume and higher unit costs that appear to justify the companies' pricing policy. In contrast, where the leading firms price low in relation to cost, smaller firms will disappear or will not be attracted into the industry, and the major firms will end up with larger volume and lower unit costs. For tractors, the North American pattern appears to be one of pricing high in relation to unit costs. In Britain the reverse appears to be true. Just why this difference in approach exists is not clear. It may be related to the characteristics of the dominant firms in each market and to historical developments. As individuals, both Henry Ford and Harry Ferguson believed in pricing low in relation to costs,

with the goal of achieving the lower unit costs that accompany large-volume production. And the two dominant firms in the British market today are the successors to firms started by those two individuals.

Because of the increasing sophistication and complexity of the machinery they produce, the major manufacturers have recognized the need to give much more support to their dealers. They provide special training courses for their service personnel, they supply service manuals and produce special dealer magazines, and they advise dealers on the management of their business and on facilities planning. However, the companies have been slower to recognize the farmer's need for more information and advice in selecting machinery to suit his needs. They are not alone in this regard. A recent book, *Principles and Practices of Commercial Farming,* prepared by the Faculty of Agriculture and Home Economics at the University of Manitoba, has in its 600 pages only one page dealing with combines, and says almost nothing at all about how a farmer decides on what is an appropriate size of machine for his operation. Yet as machines become larger and more expensive, a farmer's machinery-investment decisions become increasingly critical. It is for this reason that this Report includes a recommendation for an evaluation and testing unit that could supply farmers with much more reliable and comprehensive information to help them make their decisions on machinery investment and replacement.

In some ways the farmers and the machine companies remind one of an old married couple who have their ups and downs. The interests of both are inextricably intertwined. Farmers are highly dependent on the machinery companies for their new machines and for a prompt and reliable repair parts service. In some respects they admire the achievements of the company, especially the many improved labour-saving machines they have developed. At the same time they are often very suspicious of the major companies. They suspect them of making large profits at the farmer's expense. Some of them believe the companies bring out new machines without adequate testing.

In very considerable measure the suspicions that develop in this relationship are due to the fact that the machinery companies have had almost a monopoly over the technical knowledge and expertise in this industry. There has been almost no research into farm machinery technology at either the governmental or university level in Canada. Except for a brief period when the Agricultural Machinery Administration operated in Saskatchewan, there has been no machinery testing or evaluation beyond what was carried on by the companies themselves. As a result, the number of engineers with a thorough knowledge of the industry's problems who are not employed by the industry itself has been very limited. Even these few may be reluctant to be openly critical of the companies because they are dependent on them in various ways – for a loan of equipment for research purposes, for possible research grants, and for informal discussion of farm machinery questions. The farm journals, too, are sometimes suspected of being less than independent

because they are so heavily supported by the advertising expenditures of the farm machinery companies.

Such extreme dependency, I am convinced, is undesirable. Implementation of the various measures recommended in this Report should do much to end it. In particular, a larger research program at both the governmental and university levels, dealing with the basic problems of how farm machines operate and how farm machine systems can be designed to carry out farming operations more economically and effectively, will increase the number of engineering and other machinery specialists who are employed outside the companies. The establishment of an evaluation unit will also help reduce the farmer's present overwhelming dependence on the machinery companies' published data for information about machinery capacity and suitability.

The basic proposal being made is for a comparatively small (compared to such a body as the National Research Council) but highly expert research and evaluation unit controlled by a semi-independent governing board. The unit would have its own program of research designed to improve farm machinery. In addition it would be responsible for a greatly expanded program of research grants to Canadian universities. This would ensure a continuing flow of farm machinery technology suited to the needs of Canadian farms. It could do much to help keep them competitive on world markets. The unit or centre would also be responsible for the testing and evaluation of farm machinery and for providing farmers with reliable information to guide their investment and replacement decisions. As a general centre of expertise, the unit could also be responsible for a program of research designed to improve safety and reduce the health hazards connected with farm machinery, for developing an improved program of education on health and safety hazards, and for initiating an improved set of statistical data in this area. It should also develop a small program of research into the feasibility of more standardization, and should take a lead in attempting to initiate increased standardization. Finally, it should use its good offices to promote a smooth-functioning co-operative relationship between the manufacturers, distributors, and users of farm machinery.

The Commission was also asked to examine "the present and prospective competitive position of the Canadian agricultural machinery industry in Canadian and export markets" and to recommend "measures that could contribute to the expansion of efficient production of agricultural machinery". At the present time the Canadian share of farm machinery manufacturing in North America, about 7 to 8 per cent, is well below Canada's proportion of the region's farm machinery sales, around 12 per cent. The reasons for this disparity are not entirely clear. It is at least partly due to the fact that a number of full-line companies have no manufacturing facilities in Canada and that other major firms manufacture much less in Canada than the locational advantages of the country would appear to justify. It is clearly no accident that the only major company that manufactures more in Canada than it does in the United States is Massey-Ferguson. The lack of any major tractor plant in Canada and the failure of any of the larger companies, other than Massey-Ferguson,

to supply tractor components from Canada also contributes to a smaller Canadian share of manufacturing output.

Because the growth in farm machinery sales on this continent is slow and because the number of units of most machines produced declines as farms get larger, there is unlikely to be any major shift in the location of manufacturing plants for the industry's present products. However, farm machinery has been subject to a rapid rate of technological change and this is likely to continue. Experience in Britain and other countries indicates that small independent firms often take the lead in developing and marketing newer specialized equipment. Thus the expanded program of research into farm machinery technology recommended above should give a valuable stimulus to the growth of farm machinery production in Canada. Small independent firrns will benefit from the flow of new ideas generated by this research and from the availability of a larger number of qualified agricultural engineers in government research stations and at universities. The larger firms would be encouraged to locate more of their own research in Canada because of the much more favourable milieu that had been created for farm machinery research. And this should lead, in time, to an expansion in their manufacturing output in Canada.

In this brief introductory survey it has not been possible to do more than review some of the highlights of this Report. Many questions that have been examined at length, such as the repair parts problem, have not been mentioned here at all. To understand the industry in all its complexity the Report must be read in its entirety. Numerous recommendations have been made. These appear in various chapters throughout the Report, usually in the context of a discussion of the problem to which they relate. An index of these recommendations is appended to this chapter for ease of reference.

INDEX OF RECOMMENDATIONS

Research and Development

Safety and Health

Chapter 2

FARM MACHINERY PROBLEMS AS VIEWED BY THE FARMER, THE MACHINERY COMPANY AND THE DEALER

The Commission has received the views of many organizations and individuals about problems related to farm machinery. Before examining these problems in detail it will be useful to make a brief survey of the testimony. Particular attention will be given to the views of the farm community as expressed through their organizations, and to the views of the major farm machinery suppliers. Opinions expressed by others, including provincial governments, dealer organizations, and individuals, will also be considered. No attempt will be made at this stage to draw conclusions on the questions or problems raised. Rather, in this chapter, a broad picture of the industry and its problems will be painted. The picture will necessarily be a multi-faceted one, reflecting the many different and often conflicting points of view.

Prices of Farm Machinery and the Cost-Price Squeeze

It was repeatedly stressed before the Commission that the investment in farm machinery required for a modern and efficient farming enterprise was rising and, as a consequence, farm machinery costs were becoming an increasing proportion of total farm costs. This, in turn, made more crucial the price at which the farmer was able to buy his machinery and equipment. Many witnesses were not prepared to argue that the price of farm machinery was higher than it should be in absolute terms. But there was almost unanimous agreement among farm groups that its price had become too high in relation to the price at which the farmer had to sell his product. In effect, farm machinery costs were an important element in a more general cost-price squeeze. The Saskatchewan Wheat Pool, for example, pointed out that the prices received by farmers had risen only 3 per cent in Western Canada since 1949 whereas the price of machinery had risen 85 per cent.

While farmers did not feel fully competent to judge the reasonableness of farm machinery prices, they were clearly suspicious of present price levels. The industry's prices, it was argued, were administered. Competition might exist for sales but there was little competition in quality or price. Instances were given of

comparatively large price increases within a short period of time and of major increases for machines that had changed very little in design. The Alberta Wheat Pool wondered why tractor prices had an almost constant price per horsepower. Why shouldn't the price per horsepower on very large tractors be much lower? A number of witnesses cited evidence that prices of tractors and other machinery in Britain were lower than in Canada and asked the Commission to investigate the reason for these differences.

The difference between the manufacturer's list price and the price at which machines are actually sold by the dealer was a source of concern to some witnesses. In recent years, it was contended, the effective price was some 10 to 15 per cent below the list price, the difference being concealed by the practice of giving an excessive trade-in allowance. Some groups favoured a lower list price, arguing that the present practice made it difficult to know what the retail price really was. Others argued that there were some advantages to the farmer in the present practice, in that it made it easier for him to meet the down-payment requirements under Farm Improvement Loans Act (F.I.L.A.), and it also gave certain advantages under the Income Tax Act. The Canadian Federation of Farm Equipment Dealers pointed out that the practice of selling well below list meant that the farmer was paying less for his product than might appear from quoted list prices.

A good deal of concern was also expressed about the price of repair parts. Instances were given of large price increases on parts during the past few years. A number of people pointed out that it was possible to buy bearings from the original bearing manufacturer at prices much lower than those of identical bearings from a farm machinery company. One witness suggested that list prices be stamped on packages containing small parts. This would prevent dealers from taking an excessive mark-up. Evidence of widely different prices being charged by different dealers for the same parts suggests that such practices do occur. There were complaints, too, about the need to buy a completely assembled unit when only a minor component had failed.

The farm machinery companies admitted that prices of farm machinery had risen more than the prices of farm products, but they argued that there was little relation between these two sets of prices. Prices of farm machinery had risen, they contended, because wage rates and raw material prices had increased by more than could be offset by improvements in efficiency, despite the best efforts of manufacturers to keep costs down. This was partly due to the fact that as farm machines became larger and more sophisticated, the volume on any one type of machine had declined. Thus the industry was not able to offset cost increases by efficiencies obtained through large-scale production as was true for automobiles, trucks and other products. Because farm machines had become larger, heavier and more intricate in design they had also become more difficult and expensive to manufacture, requiring more sophisticated production machinery and more skilled labour. The increasing number of models and options required to meet the farmer's needs had also added to costs.

The failure of farm product prices to rise more was a separate problem, they argued, and some companies said that if it had not been for the greatly improved productivity of agriculture, much of which reflected the improved farm equipment available, the farmer's position would be much worse. One company questioned whether the cost-price squeeze was a problem affecting all farmers or just the smaller farms which had not kept up with modern technology or didn't have enough land and capital for an efficient operation. Was the problem of low income in agriculture a structural problem, they asked, rather than one of the level of farm prices?

All companies said that the rise in farm machinery prices had not been caused by excessive profits in the industry or by a widening of profit margins. Indeed, just the opposite was contended: the profits of the farm machinery industry had been lower than those earned in other industries. This, they claimed, was the result of intense competition in the industry. Moreover, prices to the Canadian farmer were largely set by competition throughout the North American market rather than in Canada alone, because many of the machines purchased by Canadian farmers were imported from the United States and a major share of Canadian production was sold in the U.S. market. Two major companies cited cases of tractors being sold at lower prices in Canada than in the United States, a difference they attributed to the larger amount of competition from European producers in the Canadian market.

Parts prices, they argued, were determined in relation to costs and to the competition of alternative sources such as discount stores and will-fit manufacturers (those who produce parts designed to fit the machines of many different firms). For many of the slower-moving parts, it is often difficult to recover all costs, including the costs of scrapping obsolete parts and storing, insuring and keeping in salable condition a vast array of parts. One company stated that 85 per cent of its dollar parts sales were provided by only 15 per cent of its parts numbers. The companies recognized that individual dealers might charge different prices for the same parts, but they felt this was difficult to prevent. The dealer was an independent businessman and, in the long run, competition from other dealers should prevent excessive parts pricing. One company said that its present policy provides parts to the Canadian farmer at more favourable prices than to the U.S. farmer, the Canadian price being set at the U.S. price plus a surcharge of only 5 per cent rather than the full exchange differential.[1]

Availability of Repair Parts and Service

Next to price, and for some even more important, the question uppermost in the farmer's mind was the availability of repair parts in critical periods such as seeding, haying and harvest time. A few days' delay in such critical periods could cause serious loss to the farmer. Hence it was of utmost importance that, when a

[1]This statement was made of course at a time when the Canadian dollar was pegged at .925 (U.S.) so that the full differential would be about 8 per cent.

tractor or combine or other farm machine broke down at such a time, the farmer should be able to get it repaired promptly. And farmers are far from satisfied with the service they are getting. Many examples were cited of long delays at crucial times. Many dealers, it was contended, now carry only a minimum stock of parts and depend on telephone orders to the nearest city to fill orders for all but the fastest-moving parts. Often parts had to come from outside the provinces, with delays of a week or more being not at all uncommon. Some farmers even felt that the companies deliberately created a scarcity of parts on older machines so that farmers would be forced to trade in their machines more frequently in order to reduce the risk of a critical breakdown. Instances were also cited of a shortage of parts on relatively new machines. However, some farmers felt that the service they received was good and the supply of parts adequate. Often, these turned out to be farmers who were close to large, well-equipped and efficient dealers.

Many suggestions for improving the situation were made. Many farmers felt that the machinery companies should stock a major parts supply in every province or in various parts of the province. Some felt that multi-company parts centres might be the answer. These would be parts depots located at a central point in each province and open on a 24-hour basis during busy seasons, including weekends and holidays. It was felt that repairs should be available within 24 hours in an emergency and within 48 hours in less pressing situations. Many were critical of parts availability on Saturday and Sunday and holiday weekends during busy seasons. Instances were cited where central repair parts depots would not accept orders for delivery on the same day unless they were placed by mid-afternoon. A number felt that the staff of the companies' regional or central warehouses showed little concern for the problems faced by a farmer with a machine "down" in the field. Others suggested that parts manuals should be provided to farmers so they could order parts by telephone. It was argued, too, that companies should provide cross-references in their parts list so that a farmer in an emergency could obtain an equivalent part from another supplier.

Responding to such criticism, the companies argued that it was simply not true that their parts service had deteriorated, and said a number of major steps had been taken in recent years to improve their parts operation. Almost all companies were making use of computers to keep a record of their stock of parts and to help them determine where and in what amounts different repair parts should be kept. Several major companies had introduced special programs to help their dealers manage their parts stock more effectively. The results of these programs, they contended, had been reflected in an increasing percentage of parts orders being filled directly over the counter. All companies have been engaged in upgrading their dealers, eliminating the smaller, less efficient dealers who were unable to give an adequate parts service. Although this has often meant that the farmer has to travel further in order to obtain repair parts he has a better chance of getting them when he arrives.

The repair parts problem has been complicated by an increasing number of parts. One major company reported that the number of different farm machinery parts stocked had increased from 68,000 in 1958 to over 100,000 in 1967. Some 30,000 of these had no North American sales at all in the preceding 12 months. The large number of parts in stock reflects the fact that the company undertakes to stock parts for tractors and combines for a minimum of 15 years after they stop manufacturing a given model. In practice they hold parts longer than this, and as long as there is a reasonable need for them. Other companies reported comparable experience and practices.

Nearly all companies reported that they had an emergency service which the dealer could use to obtain a part quickly when a farmer had a machine "down" in a busy season. By the use of telex communication it now is possible, they stated, to find the required part wherever it is located in North America within an hour or two. In all but 5 per cent of their emergency orders from dealers, one company stated, it is possible to obtain the part from the dealer's regional branch warehouse. A further 3 per cent can be filled from an adjacent branch. For this company, only two emergency requests out of 100 had to be filled through the company's central parts warehouse. All the major companies reported that their branch warehouse personnel could be contacted on weekends during busy seasons.

Nevertheless, it was admitted that breakdowns in the system still occurred and farmers sometimes had to wait a long time for an urgently required part in a critical period. Often these breakdowns reflected human error. The farmer might fail to communicate to the dealer the urgency of the requirement or the dealer might fail to order the part on an emergency basis. Occasionally, the company will find itself out of stock when the demand for a seldom used part suddenly increases, and a delay occurs until a new supply can be manufactured.

Farmers in more outlying areas such as Prince Edward Island or the Peace River area of British Columbia were particularly conscious of delays caused in transporting parts. However, delays apparently often occur within provinces as well, and the Commission was told of substantial time lost, just in moving parts from Hamilton to the Ottawa Valley. It was alleged that transport systems have deteriorated significantly in recent years. Many trains have been discontinued or the service cut back. Both express and parcel post are less reliable than they used to be. And buses are unwilling to take bulky parts and will not drop parts at unattended points. Delays also occur with truck shipments, particularly where a transfer has to take place at a terminal warehouse. Instances were cited of material being carried through a town and then back-hauled to it a day or two later, because of truck licensing requirements. Service on weekends is especially difficult. Offsetting these difficulties in some degree has been the increased speed of jet aircraft. Parts can now be flown from Europe virtually overnight. One company stated that all but 2 per cent of its dealers would normally receive delivery of parts within two days of shipment from its regional depots, and the remaining number would receive shipment within three days. However, another farm machinery company felt that

they were being blamed for delays that were the fault of the transportation system. Even air shipments of parts might be delayed in favour of higher-priority cargo.

When parts are shipped from the United States, further delays occur because of the need to clear customs. Although all repair parts clearly usable only on farm machinery enter Canada duty-free, they still must clear customs. Canada Customs does not provide a 24-hour service at border points for commercial shipments, and delays of several days in obtaining customs clearance can occur even on air shipments. Further, it is necessary to ship even emergency parts from U.S. sources to branch houses in Canada rather than direct to the dealer, or almost interminable delays will occur. Some delay on these shipments also occurs because special invoices have to be prepared to accompany the shipment.

Service facilities, too, were criticized. Many servicemen, it was argued, were not adequately trained, their wages were low and their work inferior. Some felt that repair centres should be able to act as dealers for more than one company in order to get an adequate volume of business and improve their service. Smaller dealers, in particular, are likely to have inadequate facilities. A number of witnesses stressed the need for dealers to have large enough trading areas to support a viable service operation. Even larger dealers apparently have difficulty retaining skilled servicemen in competition with the higher wages often offered by automotive dealers. There were complaints as well that machines were not properly adjusted before delivery, so that a farmer might have to spend a day or two adjusting a machine before it would work satisfactorily. One witness suggested that there was a lack of co-operation betweeen dealers and companies as to who was responsible for adequate servicing of new units. Some dealers were reported to be reluctant to report problems to their companies.

The Province of Manitoba suggested that certification and licensing of repair personnel might be considered after a formal training course, with service personnel required to take upgrading courses from time to time. Another witness suggested that central repair depots should have more trouble-shooters who could go out into the country and fix or adjust machines. While the trend to large dealers is apparently improving service, farmers are often farther from these centres and this creates awkward problems for machines that are too large to transport easily. Many farmers like to service their own machines and it was suggested that shop facilities should be available that a farmer could rent. At least one farm organization pointed out that not all farmers wanted better service if it was going to involve higher costs.

All the companies reported that they had active training programs designed to upgrade the skills of dealer service personnel. Generally the company pays all the expenses of providing the course except for transportation to the training location and living accommodation during the course. Some companies reported that they provided their dealers with an incentive to send personnel on such courses by offering higher rates for warranty work where company-trained mechanics were employed.

The Commission was also told of a number of courses that had recently been established in technical high schools dealing with diesel motors, farm tractors and farm machinery in general. However, in at least one province, the course being offered is in danger of being discontinued because of the very small number of applicants.

The Saskatchewan Wheat Pool suggested the desirability of diagnostic clinics for trucks and tractors in major cities and towns. A wrong diagnosis could cost the farmer many dollars. They also suggested that the servicing of hydraulic equipment had not kept pace with the increased use of this equipment. Most dealers, they reported, had reasonable facilities, but there was an urgent need for skilled mechanics, especially in medium-sized and smaller centres in the province. A number of organizations suggested that multi-line dealers would lead to improved service, since it would allow each dealer enough business to warrant well-trained mechanics.

Research, Testing and Machine Performance

Although farmers feel that models are changed too frequently and there are an excessive number of options on some machines, on the whole they think that the major farm machinery companies have done a good job in improving old machines and designing new ones. In the Saskatchewan Wheat Pool Survey, some 95 per cent of those responding felt that machines perform well the work for which they were designed. Still, a significant number of farmers felt that some design aspects of various machines were lacking either in strength, durability, or convenience of repair. At the same time many witnesses appearing before the Commission felt that research on machinery and equipment had been neglected by governments and universities. The United Farmers of Alberta Co-operative Ltd. suggested the need for a national agricultural research council, one of whose duties would be to supervise research in agricultural engineering. The Saskatchewan Government suggested there was need for more fundamental research in both the engineering and economics of farm mechanization, directed towards finding new, better and lower cost methods, machines and systems for doing farm work. Existing biological and chemical research, they argued, was insufficiently oriented to engineering requirements. For example, there was need for data on the optimum depth, temperature, moisture content, pressure, fineness, uniformity, etc., for the best growth and health of plants. Basic data of this type would enable engineers to produce better farm machines. The Government of New Brunswick pointed out that in the United States and Europe agricultural engineering research receives from 5 to 10 per cent of the agricultural research budget, compared with only about 2 per cent in Canada.

A number of witnesses linked research and testing and suggested that a single agency should carry out both functions. An independent testing authority was recommended by almost every farm organization appearing before the Commission. Farmers, it was argued, need unbiased data on the capacity, efficiency and

performance of machinery under different conditions, rather than the high-pressure sales campaigns of the machinery companies. The need for tests as to the suitability of machinery for conditions in different regions was repeatedly stressed. Many organizations commented favourably on the experience of the Agricultural Machinery Administration (AMA) in Saskatchewan and felt something similar to it should be revived on a regional or national basis. The Saskatchewan Wheat Pool reported that 141 out of 178 respondents favoured independent comparative testing such as the AMA had provided. The Manitoba Farm Bureau reported that 80 per cent of those canvassed favoured testing by an independent body. However, the Government of New Brunswick was not in favour of a national testing body if it would inhibit the development of an expanded program of engineering research.

It was also suggested that a national testing body could test on a fee basis for individual designers and small manufacturers. In addition, new equipment developed in other countries could be tested for its suitability to Canadian conditions. If combined with a research agency, the testing agency could act as a co-ordinating body for new developments in research in agricultural engineering, helping to draw these to the attention of farmers. Farmers often feel that the power and performance claims of the farm machinery manufacturers bear little relation to reality, and it was suggested that a testing agency could act as a sort of a policeman in this area, drawing attention to false or misleading advertising.

To be fully effective, one witness contended, machines should be tested both before and after new models are introduced. Moreover, testing should cover both durability and suitability, and durability testing should include both testing in the field and bench-testing of components.

The machinery companies almost uniformly took a negative attitude towards a public testing agency. They argued that such a body would merely duplicate the very extensive tests that are now being carried out by the companies. One company described its testing program on new machines in some detail. This program includes intensive laboratory testing of machine components, and a laboratory test of the first prototype machine designed to test its structural strength and the wear on moving parts. This latter test gives the machine the equivalent of several seasons of intensive use. A number of machines are then tested by farmers in carefully selected locations under various soil and crop conditions. By testing in different parts of North America it is possible to get the equivalent of two or more seasons of use on a seasonal-type machine within a single year. Each machine is accompanied by a technician in the field and at the end of the season it is returned to the engineering department where the test group takes the machine apart and checks each component to see how it has stood up under actual operating conditions. If the results are satisfactory, the machine may be tested again a second year before approval is given for a pre-production run. Some of these will go to farmers who test machines for the company and some will again be followed by the company's own test group. Only when the new machine has been thoroughly evaluated, this company reported, will it be released for full production tooling.

While for the most part the machinery companies found the tests carried out by the AMA were satisfactory, they argued that most of the defects discovered by that organization had already been brought to their attention and corrected before the AMA report appeared. On the other hand, they almost all felt that universities and government agencies could perform a useful role in the research area, particularly in developing basic data about the characteristics of various machines and in developing new machines for specialty crops where the small volume would preclude a satisfactory research effort by a private company.

Warranty Arrangements

Farmers vary in their attitude towards present warranty arrangements. The Saskatchewan Wheat Pool reported that about half of those who responded to its survey felt that present arrangements were satisfactory, whereas the other half felt they should be improved. Many farmers apparently feel that a one-year warranty is not adequate on machines such as combines which are often only used for a few weeks of the year. The most frequent suggestion was for a warranty in terms of hours of use with machines being equipped with sealed hour-meters. The Western Manitoba Farm Business Association recommended that warranties be extended to cover 1,000 hours of use on combines and 4,000 hours on tractors. They felt that most of the machines now being sold could live up to such a warranty.

Difficulties sometimes arise where the warranty period expires before the machine is satisfactorily repaired. It was suggested that the warranty period should be extended until the machine is working properly and that the warranty should cover parts replacing those originally found to be defective. Another witness recommended that warranties be written so that the intent is clear and that they be simple to carry out. Dealers should be required to explain warranties to the purchaser at the time the machines are sold. It was argued, too, that the practice of voiding warranties where the customer did not use special company-marketed materials was not in the public interest. Several witnesses suggested that warranties of limited duration on reconditioned second-hand machines would serve a useful purpose.

In Prince Edward Island, the Federation of Agriculture complained of long delays in the implementation of warranties and said the farmer had difficulty in determining whether the dealer or the company was responsible. The Federation suggested the need for an appeal board to review warranty complaints.

The dealers, too, voiced dissatisfaction with present warranty arrangements. The usual company warranty policy does not cover the full financial costs incurred by the dealer in handling warranty work. The Canadian Federation of Farm Equipment Dealers pointed out that dealers have to absorb freight and telephone costs, the expense of picking up and returning the farmer's equipment, and up to 50 per cent of the shop service costs.

For their part, most of the companies felt that a year's use was adequate to show up any original defects in material or workmanship, which was all that the warranty was intended to cover. They claimed that the warranty was often misunderstood, with many farmers expecting it to cover ordinary wear and tear as well as original defects. However, one company said they warranted their machines for as long as they were in use, and another company reported that they would be willing to offer a longer warranty period if warranty on farm machines was not so difficult to administer. All the major companies reported that in implementing their warranties they provided parts at dealer cost and covered servicing costs at standard labour rates.

Model Changes, Standardization, Safety and Finance

Many farmers feel that fewer model changes would reduce manufacturing costs, simplify the stocking of repair parts, and reduce the rate of obsolescence on parts and machines. They accuse the farm machinery companies of following the practice of the automobile industry in deliberately fostering obsolescence by frequent model changes. Farmers, they argue, often bear part of the costs of testing and of removing the bugs from the new models. At the same time, they recognize that equipment has improved over time so that new models are justified from time to time.

Farmers also find it difficult to understand why there is not more standardization in the industry. More standardization would, they believe, reduce inventory and bookkeeping costs, allow more bulk buying and enable farmers to obtain needed repair parts with less delay. They cite belts, chains, batteries, oil filters, pulleys, tires, wheels, knife sections, guards, axles, shafts, sprockets, canvases, generators, starters, and bearings as components that should be standardized both among machines and among companies. They also suggest the need to standardize hydraulic pressures and couplers and identify hydraulic oil with an SAE number (specification of the Society of Automotive Engineers). One witness also suggested the need for a code of minimum requirements for belts, chains, wheels, tires, hydraulic hose, and similar items.

In respect to safety, concern was expressed about the alarming increase in the accident rate. The Commission was told about the high noise level that often exists in tractor cabs, and about the high incidence of back ailments among farmers who have driven tractors and travelled on farm machines for many years. One doctor who appeared before the Commission suggested that more care and standardization in the location of the controls on tractors and other machinery might help in achieving a higher level of safety.

A number of witnesses expressed satisfaction with the availability of funds under F.I.L.A. However, some felt the $15,000 ceiling was too low. It was also suggested that it should be possible to combine separate farm improvement loans

and arrange for a longer repayment period. Other witnesses recommended that the legislation be revised to enable farmers who take advantage of interest-free finance plans to utilize the Farm Improvements Loans at the end of the interest-free period.

On these various questions the companies invariably offered a contrasting point of view. Model changes, they argued, were necessary to incorporate new improvements in farm machines and these often resulted in lower costs to the farmer. The farmer had shown a demand for more sophisticated equipment and for more comfort and ease of handling, and the industry was doing its best to provide him with what he wanted. The growing volume of research provided a continued flow of new developments, and competition enforced the incorporation of these developments in new models. One company defended the large number of options and sizes of equipment it offered as necessary to meet the varied demands of the many different sizes and types of farm operations.

In regard to standardization, the companies said substantial progress had already been achieved through various engineering societies. Among major contributions, they cited the standardization of power take-off and drawbar dimensions to permit safe coupling of implements to all makes of tractors, worldwide standardization of the three-point hitch to permit integration of all mounted implements with tractors, standardization of power take-off pulleys and belt speeds for power-driven equipment, hydraulic coupling standardization for remote-controlled implements, standardization of operator controls on farm tractors, establishment of safety lighting standards, development of slow-moving-vehicle signs for safety, and the development of hundreds of miscellaneous standards for fasteners, materials, fuels, lubricants, electrical systems, hydraulics, threads, splines, and V-belts.

Some companies reported very substantial progress in standardization among different models of their own equipment. One company reported that for its new line of tractors the same basic tractor models are sold throughout the world, and on all models 19 major items have complete interchangeability. This includes water pumps, connecting rods, oil pumps, cylinder blocks and heads, transmissions, axles and hydraulics. It was also argued before the Commission that cost considerations made it unwise to carry standardization beyond a certain point. Some machines require heavier and stronger components than others and to provide standard components for all would add to the cost of the lighter machines.

Many of the companies expressed concern about operator health and safety in their submissions to the Commission. They said the design of safe equipment was a constant area of study, and were able to point to substantial improvements. These improvements include non-skid platform surfaces, safety lights, cushioned and spring-loaded seats with back support, low-elevation fuel tanks, and numerous safety shields and warning stickers. Although they are not often purchased, roll bars and safety belts are available on some tractors.

PART II

MARKET STRUCTURE AND COMPETITIVE BEHAVIOUR

Chapter 3

HISTORICAL BACKGROUND

The appearance of farm machinery manufacturing as a significant industry in North America can be traced back to 1831 when Cyrus McCormick developed a successful reaper, and to 1837 when John Deere pioneered the first steel plow. In the early stages of its development the industry was characterized by a large number of firms, each concentrating on a single implement or a related line of implements such as harvesting machinery, tillage implements, or seeding equipment. At first, machinery was sold through local agents who received a commission on their sales. The early history of the industry was also characterized by an emphasis on acquiring patents and on the prosecution of rival firms who were suspected of infringing these patents. With further growth of the industry, patent pools developed and a series of mergers occurred as some of the larger firms attempted to secure a more dominant position in particular markets and thus reduce the level of competition. The most spectacular of these was the formation of the International Harvester Company in 1902 by the five largest producers of harvesting machinery in the United States. This merger brought 90 per cent of binder sales and 80 per cent of the mower trade in the United States into the hands of a single firm. A number of years earlier, in 1891, the two largest Canadian firms, the Massey Company and the Harris Company, had merged to form the Massey-Harris Company. However, their share of the binder trade in Canada at that time, about 60 per cent exclusive of imports, was appreciably lower than International's share of the U.S. market.

This trend towards consolidation of competing firms in particular fields was followed by a gradual evolution of full-line companies. Shortly after its formation, the Massey-Harris Company, which initially had been primarily a harvesting firm, began to acquire other firms which had specialized in the development of plows, wagons, and seeding and cultivating equipment. After 1910, International Harvester, too, began to branch out into new lines of implements, and by 1919 when it first entered the plow business it was producing some 54 different kinds of machinery compared with only 9 in 1902. Other firms followed suit, and by the end of the 1920s most of the present full-line companies had emerged. Certain distribution economies fostered this development. The full-line firm offered a more

effective marketing mechanism, allowing the firm's agent more continuous employment throughout the year. Similar economies would accrue to the firm's own distribution network. To some degree there may also have been economies on the production side.

Another major development in this period was the tractor revolution. Huge steam tractors had been developed in the latter half of the nineteenth century, but their use for field work was confined to plowing, and even this was limited to the large open tracts of land on the Prairies of Canada and the United States. The use of the internal combustion engine for tractors began about 1900, and by 1910 there were scores of manufacturers turning out tractors for farm use. Some of these early machines were huge monsters weighing 10 or 11 tons and generating 60 HP.

However, with the entry of Ford into the tractor business in 1917 there was a rapid shift towards a light tractor, and Ford soon secured a large share of the market with his Fordson, a 20 HP model. By organizing his production along mass production lines, Ford was able to reduce costs and cut prices sharply, reducing his price from $885 in 1919 to $395 in 1922. Fordson sales exceeded 100,000 units in both 1923 and 1925. However, Ford's success in the tractor business was short-lived. He was handicapped in securing effective dealer representation because he did not have a line of tillage, seeding and harvesting equipment to go with the tractor. Moreover, the Fordson had a tendency to flip over backwards, and Ford did little to improve his design. In addition, his principal competitor, International Harvester, was able to pioneer a number of improvements in tractor design which undermined Ford's competitive position. These included the development of an "all-purpose, row-crop" tractor and the power take-off. The usefulness of the tractor was further increased in the early 1930s when Allis-Chalmers pioneered the use of rubber tractor tires. An Irish inventor, Harry Ferguson, also made a number of notable contributions to the tractor's development in this period. These included the principle of attaching plows and tillage implements so they became an integral part of the tractor, and the use of hydraulics to control the depth of implements.

During this period the leading Canadian firms, Massey-Harris and Cockshutt, faced a difficult problem in adapting to the tractor revolution. For a short period, from 1917 to 1923, Massey-Harris produced a tractor modelled after one being built in the United States, but the removal of the tariff on low-priced tractors in 1918 eventually forced an end to this production. In 1927, Massey-Harris made arrangements to market the Case Wallis tractor in Canada, and later in the same year they acquired in its entirety the company that manufactured this tractor in the United States, the J. I. Case Plow Company. In 1928, Cockshutt acquired the right to market the Allis-Chalmers tractor in Canada, but two years later Allis-Chalmers acquired the Rumely Company and, with it, its own Canadian distribution network. Compelled to shift to another source, Cockshutt arranged to market tractors for the Oliver Farm Equipment Company. At the onset of the Great Depression in 1929, Cockshutt and Massey-Harris were still at the stage of adapting their operations and their line of equipment to tractor farming.

Another major development in the 1930s was the introduction of the combine harvester. Some combines pulled by as many as 40 horses had been used in California as early as the 1890s. In Canada, Massey-Harris began to test and develop combines as early as 1906, and was exporting them by 1910. The first successful use of a combine in Canada was at the Dominion Experimental Farm at Swift Current in 1922 when the Massey-Harris Reaper Harvester No. 5 was tested. Within a decade, all the major U.S. full-line companies were producing combines. However, although a number of combines were sold in Canada and the United States during the twenties and thirties, the combine did not become a major production item until after the Second World War, and Cockshutt did not begin producing a combine until that time.

With the development of the tractor and combine, and other more complex machinery, the major machinery companies gradually shifted from selling through commission agents to the establishment of independent dealers. The dealer, in turn, began to assume responsibility for maintaining a stock of repair parts, and for providing shop facilities and mechanics to service the equipment they sold. The increasing importance of second-hand equipment, especially second-hand tractors and combines, also encouraged this development; an independent dealer was a more effective and less risky method of selling machines where trade-ins were a significant element. This shift from commission agents to dealers had largely been completed in the United States by the 1930s. In Canada it did not take place until after the Second World War. One company attributed this delay to its inability in the earlier period to find dealers with the capital needed to get established on an independent basis.

Thus, by the end of the 1930s, the farm machinery industry in Canada was dominated by a few major firms who were producing what, by modern standards, was a technically unsophisticated product. For the period from 1926-35 it has been estimated that four firms accounted for about 76 per cent of the total sales of farm machinery and parts in Canada (Table 3.1).

TABLE 3.1 – GROSS SALES OF FARM MACHINERY AND PARTS, CANADA, 1926-35

	$ Million	Per Cent
International Harvester	129.0	33.0
Massey-Harris	75.3	19.2
Deere & Company	48.0	12.2
Cockshutt (including Frost & Wood)	45.6	11.6
Four largest firms	297.9	76.0
Industry total (estimated)	392.0	100.0

Source: Canada, House of Commons, Special Committee on Farm Implement Prices, *Minutes of Proceedings and Evidence* and *Report*, Nos. 1-20, Sess. 1937.

The general character of the 1941 market - prior to the wartime restrictions on output — is shown in Table 3.2. By that time tractors accounted for about 40 per cent of the industry's total sales, and its other sales were distributed over a great variety of items. Combines, which were of growing importance, accounted for only about 9 per cent of total sales. A significant characteristic of the industry was the relatively small production volume for individual implements. With this production scattered among a number of firms, even the largest firm was usually producing, at the most, a few thousand of each implement; for many items production would be numbered in the hundreds. The prewar Canadian industry was oriented mainly towards supplying the domestic market. Massey-Harris was an exception here, for their Canadian sales in the late twenties were only about one-third of their worldwide sales, and they had only begun to acquire production facilities in other countries.

TABLE 3.2 – PRODUCTION AND SALES OF FARM MACHINERY, CANADA, BY TYPE, 1941

	Production	Sales	
	Number	Number	$ Thousand
All Farm Machinery			52,106
Planting and Seeding Machinery, Total			2,129
Grain drills	7,944	4,644	1,094
Manure spreaders	4,019	5,624	872
Tillage Machinery, Total			7,415
Field cultivators	5,996	5,948	869
Rod weeders	n.a.	1,189	136
Disk harrows	9,564	9,909	960
Plows	25,800[1]	36,990	4,668
Haying Machinery, Total			1,836
Mowers	11,218	10,549	1,111
Harvesting Machinery, Total			7,587
Grain binders	8,893	5,556	1,576
Combines	n.a.	4,209	4,747
Swathers	n.a.	415	154
Threshers	n.a.	886	790
Tractors and Engines, Total			23,188
Tractors	n.a.	22,103	22,139
Other Farm Equipment, Total			9,950
Cream separators	19,588	32,783	1,894

[1] Excludes single-furrow plows.

Source: Dominion Bureau of Statistics, Merchandising and Services Division, *Farm Implement and Equipment Sales,* 1936-43, various years.
DBS, *The Farm Implements and Machinery Industry,* Cat. No. 42-202, 1941.

While farm machines had been improved substantially over a period of years, technical progress in the industry could scarcely be considered rapid. Research and development in its modern sense was virtually in its infancy. Except for changes made to adapt them for use with a tractor, many implements such as the binder,

the mower, the grain drill, and the moldboard plow had changed very little for several decades. The development of a tractor suitable for widespread use in farming represented a major contribution, but the tractor of this period was still a relatively unsophisticated product. As Mr. J. D. Wormley of the Oliver Corporation told the Commission, "The tractor in 1945 consisted principally of an engine, a simple transmission, some sort of a fixed or swinging drawbar, a set of wheels and a steering wheel, and that is about all."[1] Engineering and development expenditures by Massey-Harris, the major Canadian firm, averaged $361,000 per annum between 1925 and 1929, just a little over 1 per cent of sales. In the early thirties these expenditures were increased to an average annual level of some $510,000 or about 4 per cent of the depressed sales level of this period.

Unlike the industry in the United States, which had already moved to a dealer distribution system, the industry in Canada in the 1930s was still selling through agents who worked on a commission of about 16 per cent of the cash price to the farmer. The agents agreed to sell implements and parts only on the terms specified in the company's published price lists although, in fact, agents apparently sometimes gave away part of their commission in order to make sales. It was reported to the 1937 Special Committee on Farm Implement Prices that, in 1935, the three major companies had 7,300 agents. In terms of this total, annual net sales (net to the company) per agent in 1935 would be less than $2,000. These agents were supported by a network of branch houses (at that time International had 17, Massey-Harris 13, and Cockshutt 13) which maintained a stock of implements and parts, and supported and supervised the company's sales and collections. In addition to selling, the agent was frequently required to set up and deliver machines, and assist in the collection and settlement of accounts. Each agent was given a number of machines for display purposes and was supplied with a stock of parts on consignment. When a sale was made the machine was usually forwarded from the nearest branch house. New machinery was usually sold either for cash or with a 25 per cent down payment, the balance coming due in one or two payments on the 1st of October of the current and the following year.

With a third of the market, International Harvester was the acknowledged price leader in the industry and, given the dominant position of the major firms, it was possible for the industry to maintain a remarkably stable price level throughout the twenties and thirties. An index of farm machinery prices in Canada remained almost unchanged from 1925 to 1930, declined about 5 per cent between 1930 and 1933, and had regained its 1929 level by 1936. Partly because of the sharply higher tariffs imposed in 1930 and the shift to Canadian sources for a larger part of Canadian supplies, the price decline in Canada was substantially less in the early thirties than the 16 per cent decline that took place in the United States. In testimony before the House of Commons' Special Committee on Farm Implement Prices in 1937, a vice-president of Massey-Harris argued that any price reduction at

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[1]Royal Commission on Farm Machinery, Trancript of Evidence, *Hearings,* Vol. No. 28, November 13, 1967, p. 2899.

that time would merely have added to the company's losses without stimulating any significant increase in the volume of sales.

To sum up, at the end of the 1930s the industry was dominated by a small number of firms that controlled both the production and distribution of farm machinery. Although the increasing sales of tractors and combines and the growing sophistication of equipment generally was gradually to make the existing distribution pattern untenable, the industry at the time assumed the major responsibility for supplying repair parts and service. Trade-ins were not then a significant problem, and implements were, for the most part, of a type that farmers could service themselves if the necessary repair parts were provided. Further, before the advent of the combine, the timing of harvesting operations was less critical; farmers had apparently not become fully aware of the importance of timely seeding and tillage operations. Thus service and repair parts supply could be handled adequately through the company's regional system of branch houses.

Chapter 4

STRUCTURE OF THE INDUSTRY IN CANADA

The farm machinery companies that distribute their product in Canada can be conveniently classified into four groups – full-line, long-line, short-line, and short short-line companies. Full-line companies are those offering the most complete range of all types of farm machinery, supplying models and sizes suited to all types of soils and crops, and having their own national distribution systems. This includes Massey-Ferguson, John Deere, and International Harvester. Long-line companies are those which offer a fairly extensive range of farm machinery, but often specialize in equipment suited to particular areas or for particular farm operations. These companies usually have their own distribution system but do not offer as complete a range of equipment, and what they do offer is often available in fewer sizes and models. This group includes New Holland, Ford, Versatile, and Canadian Co-operative Implements Limited (C.C.I.L.). Short-line firms are those which produce and sell a specialized range of products. They sometimes distribute these through their own exclusive dealers but more often sell through the dealers of full- or long-line companies. Firms in this category would include New Idea and Allied Farm Equipment. The short short-line firms are those who specialize in the manufacture of a single line of equipment. They often sell their product through independent distributors who handle the products of a number of farm machinery manufacturers. This group would include firms such as Morris Rod-Weeder Co. Ltd., Noble Cultivators Limited, and Thomas Equipment Ltd. None of these categories are precisely defined and there may at times be some doubt whether a particular firm should fall in one category or another. Nevertheless, this classification provides a useful approach to the industry and will be used in the following discussion of the industry's structure.

The Full-Line Companies

There now are six companies selling farm machinery in Canada that fall fairly clearly into the category of full-line companies. These are, in addition to the three cited above, Case, Allis-Chalmers, and the White Motor Company which sells its Minneapolis-Moline products in Western Canada and Cockshutt equipment in all parts of Canada except Quebec where it markets under the Oliver name. Recent

changes in the size and characteristics of each of these firms will be discussed briefly.

Massey-Ferguson The only Canadian farm machinery company that has acquired international status, Massey-Ferguson has experienced rapid growth over the past few decades. Between 1939 and 1968 the company's total world sales increased from $21 million to $917 million (Can.). A number of factors accounted for this dramatic growth and of these, the following appear to have been the most important. In the early postwar years, 1947 and 1948, the predecessor company, Massey-Harris, acquired manufacturing facilities or interests in Britain, South Africa, and California. In 1953, Massey-Harris and Harry Ferguson merged their interests, giving the successor company the rights to the Ferguson system of hydraulics and three-point-hitch linkage for mounted implements, along with a tractor assembly plant in Detroit. In ensuing years the new company built a new combine plant in Eschwege, Germany, acquired complete control of H. V. McKay Massey-Harris in Australia, purchased a plant to build industrial and construction machinery in Kansas, started a tractor plant at Sao Paulo, Brazil, and acquired the Borg-Warner transmission and axle plant in Detroit. A major new development occurred in 1959 when Massey-Ferguson acquired F. Perkins, Limited, of Peterborough, England, the world's largest manufacturer of diesel engines. In subsequent years, Massey-Ferguson acquired Standard Motors' tractor plants in England and France and the Landini tractor plant in Italy; completed a new tractor plant in Beauvais, France; began to manufacture combines, trucks, and tractors in Spain, and tractors and other farm equipment in India; constructed a new combine plant in Brantford, Ontario; acquired Badger Northland, a farm materials-handling firm in Wisconsin; acquired a plant for the manufacture of farm implements in Des Moines, Iowa; and purchased a plant near Akron, Ohio, for the manufacture of new and heavier industrial and construction machinery. It has also built an industrial and construction machinery plant near Rome, Italy. By 1968, farm machinery accounted for 66.4 per cent of Massey-Ferguson's sales, engines for 12.1 per cent, industrial and construction machinery for 10.4 per cent, and parts for the remaining 11.1 per cent. Of its total 1968 sales, 7.9 per cent were in Canada, 30.2 per cent in the United States, 36.8 per cent in Western Europe, 7.1 per cent in Australasia, 6.9 per cent in Africa, 7.2 per cent in Latin America, and the remaining 3.9 per cent in Asia.

Compared with its position in 1939, the company had clearly become not only very much larger, but also much more diversified on both a country and product-line basis. In 1939, 35 per cent of the company's sales were in Canada. The company had not yet entered the industrial and construction equipment field, and had not yet acquired a major manufacturer of diesel engines. The acquisition of Perkins was part of a general move towards a more completely integrated operation under which the company began to manufacture a much higher percentage of the components contained in its various products. In addition, as described elsewhere in this Report, the company has moved substantially in the direction of a worldwide

standardization of products and worldwide specialization in the production of basic components. Thus, if Massey-Ferguson were to be judged on the basis of its position in the Canadian market alone, its strength and competitive power would be seriously underestimated. Through its worldwide operations Massey-Ferguson obtains cost advantages arising from economies of scale on longer production runs and from its ability to position its manufacturing operations in low-cost locations. Its large scale undoubtedly provides it with substantial economies in research and engineering and perhaps also in marketing and managerial skills.

International Harvester – In the late twenties International Harvester was the dominant firm in the Canadian market and was estimated to sell about one-third of all the farm machinery sold in Canada. Since then, its relative position in the Canadian market has declined substantially. On a worldwide basis International Harvester is a very large firm. In 1968, its total sales were more than $2.5 billion (U.S.), of which some $883 million was farm equipment and service parts, $1,145 million motor trucks, and $329 million construction equipment. Although the company has an important international business, almost 75 per cent of its total sales are in the United States with Canada accounting for just over 6 per cent. The firm's important position in trucks and construction equipment provides a basis in technology which must be of substantial assistance to the company's farm equipment operations. In 1968, the company reported research and engineering expenditures of $80.8 million, just over 3 per cent of total sales, a ratio the company has maintained for a number of years. Since the cost of research on components such as engines and transmissions can be spread over all three of the company's major product divisions, the advantage to the farm equipment division is evident. In 1967, International became the first company to make hydrostatic transmissions available on farm tractors. Although the company does not make available a breakdown of its farm equipment sales by region, it manufactures farm machinery in Australia, Britain, France, Mexico, South Africa, Sweden, and West Germany, as well as in Canada and the United States. Its highest market penetration is believed to be in the United States.

John Deere – A third major firm, Deere & Company, sells in Canada through John Deere Limited. In the late twenties and early thirties it was estimated to hold about 12 per cent of the Canadian market. At that time it was concentrating its sales effort in Western Canada. Since then, it has expanded its sales effort in Eastern Canada, and its share of the Canadian market has increased. Its 1968 sales of farm equipment of $843.2 million (U.S.) were just marginally lower than those of International Harvester. Until the mid-fifties, the company concentrated its sales effort mainly in North America but since that time it has been making a major effort to increase its share of European and other world markets by acquiring or building manufacturing facilities abroad. By 1966, Deere had manufacturing facilities in Germany, France, Spain, Mexico, Argentina, and South Africa, and had licensed some of its tractors and implements for production in Japan. In recent years Deere & Company has placed a major effort on research and development and

in 1963 it opened an advanced research centre. In 1968 its expenditures on research and development totalled $49 million, about 4.8 per cent of sales. Deere has also entered the industrial equipment field and its sales in this field amounted to $145 million in 1968. In addition, it sold about $43 million worth of lawn and garden equipment. Deere does not publish an international breakdown of its sales, but in 1968 about 74 per cent of its total assets were in the United States, 7 per cent in Canada, 12 per cent in Western Europe, and the rest in Latin America and elsewhere.

Cockshutt White Motor — The White Motor Corporation, a long-time manufacturer of cars and trucks, entered the farm machinery business in the early sixties, acquiring the Oliver Corporation in 1960, Cockshutt Farm Equipment Limited - one of the two major Canadian firms - in 1962, and Minneapolis-Moline in 1963. Prior to this time, all three of these firms were in active competition with one another in the Canadian market. After their acquisition by White Motor, the Cockshutt name was dropped in the United States and the Oliver name in Canada (except in Quebec), while Minneapolis-Moline continued to sell under its own name in both countries. However, the manufacturing operations of the three firms were consolidated, with Cockshutt producing combines and swathers for all three brands at Brantford (swather production was later shifted to Winnipeg), and with Oliver producing tractors and other farm equipment under both the Cockshutt and Oliver name. Minneapolis-Moline continued to produce its own line of large tractors and some other tillage equipment but also sold the Cockshutt combine and many Oliver implements under its own brand name. Under the new management, all three firms placed a major emphasis on catering to the larger, more progressive farms, and concentrated their sales in the corn and wheat belts in Canada and the United States. At the end of 1968, the farm machinery operations of the three divisions were consolidated as the White Farm Equipment Division, with the brand names Cockshutt and Minneapolis-Moline retained in Canada. At this writing, White Motor's farm equipment sales are largely confined to the North American market, although some steps have been taken to expand its sales in Europe. In 1966, the company acquired a major interest in Arbos, an Italian combine manufacturer. In addition, the smaller-horsepower line of tractors, sold under both the Oliver and Cockshutt brand name, are produced by Fiat in Italy. Both Oliver and Minneapolis-Moline also produce and sell industrial equipment, but Cockshutt has not entered this field.

In the late twenties and early thirties, Cockshutt ranked fourth in Canada with about 11.6 per cent of the total farm machinery market, just behind John Deere. However, in the postwar period it failed to expand as rapidly as other major firms and when farm machinery sales slumped after 1953 it suffered losses in four out of five years from 1954 to 1958. Faced with the prospect of increased competition in the Canadian market after the removal of the Canadian tariff in 1944, Cockshutt made a major attempt to penetrate the U.S. market in order to establish a larger-volume operation. About the same time, it began to produce

tractors and self-propelled combines. It first attempted to enter the U.S. market by selling through a number of co-operative distributors of farm supplies. However, in the face of continuous losses, the co-operatives gradually abandoned the distribution of farm equipment, and Cockshutt was forced to set up its own dealers in an attempt to maintain its sales and provide service to the farmers who purchased Cockshutt equipment. It also acquired the manufacturing plant at Bellevue, Ohio, that had been owned by National Farm Machinery Cooperative, and Gamble Stores, Inc., but this had to be closed down a few years later. Because of its limited volume, Cockshutt found it difficult to compete effectively against the major firms in the industry.

Testifying before a House of Commons Committee in 1961, Mr. J.D.V. Adams, Cockshutt's Market Research Manager, stated:

> In spite of the fact that there has been no American tariff on farm machinery since 1913, no Canadian producer has ever secured substantial sales in the United States without first acquiring substantial productive facilities in that country. In our own case, we attempted to circumvent this necessity through selling arrangements with the national farm machinery cooperative in the United States after the war. Despite some early success, these have all but broken down in the depressed markets of recent years.[1]

In Canada, too, the company faced certain difficulties. In the early postwar years, it sold its equipment on the Prairies through the newly formed Canadian Co-operative Implements Limited as well as through its own franchised dealers. This competition from a co-operative distribution network was a source of dissatisfaction among Cockshutt dealers. Although the Cockshutt tractor had some success, the self-propelled combine secured greater acceptance. Indeed, one of the major reasons why White Motor acquired Cockshutt was to obtain the rights to its combine. White also saw the Cockshutt acquisition as a way of strengthening the distribution of Oliver products in Canada, and the two dealer networks were consolidated shortly thereafter.

Total sales of White Motor, the parent company, were $851 million (U.S.) in 1968, of which 61 per cent were trucks, 23 per cent farm equipment, and 16 per cent industrial equipment. Its total sales of farm machinery in 1968 would therefore be about $197 million. Sales of repair parts and service, for all groups including truck repair depots, were 19 per cent of total sales. The company acquired in 1968 the Euclid division of General Motors, a major producer of earth-moving and mining machinery.

J. I. Case – Another full-line company, the J. I. Case Company, has no manufacturing plants in Canada but supplies its Canadian market from plants in the United States, except for a few products such as swathers and chisel plows which

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[1]Canada, House of Commons, Standing Committee on Agriculture and Colonization, *Minutes of Proceedings and Evidence*, No. 14, Fourth Session, Twenty-fourth Parliament, 1960-61, p. 1139.

are manufactured under contract by smaller firms in Western Canada. In its early stages the company specialized in threshing machines and steam engines, but it began producing plows in 1919 and had become a full-line manufacturer by 1929. After the Second World War it began producing construction and earth-moving equipment as a result of its merger with the American Tractor Company in 1957. The company has experienced a number of difficulties over the past two decades. Its sales declined from $186 million (U.S.) in 1949 to $82 million in 1956 and its profits dropped during the same period from $17.6 million to less than $1 million. After its merger with American Tractor it enjoyed a brief revival, only to experience losses totalling $73 million in the three years 1960 to 1962. In 1964 the Kern County Land Company acquired a controlling interest in the company, and the company has subsequently enjoyed a significant recovery, its sales rising from $167 million in 1963 to $357 million in 1968. Of its total sales of all products in 1968, 73 per cent were in the United States, 16 per cent were in Canada, and 11 per cent were in other countries. No breakdown is available on the distribution of the company's sales as between farm machinery and other products. Although the company's sales position has improved greatly, its net profit after tax in 1968, about $3.6 million, was only about 1 per cent of its total sales. J.I. Case came under the control of Tenneco Corporation in 1967 when Tenneco purchased Kern County Land Company which held 57 per cent of J. I. Case Co. common stock.

Allis-Chalmers - Still another full-line company is Allis-Chalmers, Rumely, Ltd. Like Case, the Allis-Chalmers Manufacturing Company supplies its Canadian market from its U.S. plants. Allis-Chalmers started out as a manufacturer of flour-milling equipment in 1847, later added pumps, steam engines, and mining equipment, and after 1900 became a highly diversified company. In addition to farm machinery it manufactures construction machinery, lift trucks, heavy electric products, and a wide range of defence and other products. It also operates farm machinery plants in Britain and Australia. The company's total sales in 1968 were $767 million (U.S.), of which some 30 per cent are estimated to be tractors and other farm equipment.

The major full-line firms in the farm machinery industry are all industrial giants ranking well up among the largest corporations in North America. On the basis of *Fortune*'s list of the 500 largest corporations in the United States (1969), the above six companies ranked as follows: Massey-Ferguson 117th, International Harvester 31st, Tenneco (the Case parent holding company) 34th, Deere & Company 112th, White Motor 118th, and Allis-Chalmers 140th. In addition, three other major industrial firms, Ford, Sperry Rand, and Avco, have significant farm machinery operations, described below. These three firms ranked 3rd, 60th, and 129th in *Fortune*'s 1969 list of largest industrial corporations. The rank given for Massey-Ferguson is the rank it would have held if it had appeared in *Fortune*'s list of industrial corporations in the United States.

The Long-Line and Short-Line Companies

The full-line companies, which stock and sell a wide range of equipment including a line of tractors, and harvesting and haying equipment, are subject to varying amounts of competition from long-line and short-line companies. Many of the smaller firms concentrate on a single product or on a very limited range of products. Often they market their products in a single area or region. In some instances they may sell part or all of their output to one or more of the major full-line companies. In a few cases a short-line firm may concentrate exclusively on manufacturing, under contract, the products being sold under a major company's brand name. In other cases, part of the firm's output may be manufactured under contract for the major company, with the balance being sold through distributors. Still other firms may hire their own salesmen and supply their product directly to farm machinery dealers. Often these will be dealers who are franchised by one of the full-line companies. Less frequently a dealer may operate by representing a number of short-line companies. In some instances this occurs when a long-line franchise has been cancelled and the dealer wishes to continue.

While competition from the short-line firms helps to keep selling prices responsive to costs and helps prevent the emergence of monopoly profits, this advantage to the farmer may be partially offset by more uncertainty as to the suitability and durability of their machines and by the greater risk that repair parts may not be readily available from the short-line companies. This latter risk arises out of the higher rate of turnover of short-line companies. From time to time a number of these firms fail, or go out of business for other reasons, and the farmer who has purchased the firm's equipment may be unable to secure repair parts. The Province of Saskatchewan has attempted to reduce this risk by requiring every firm who sells farm machinery in the province to appoint a distributor who will undertake to stock repair parts for the firm's equipment for a period of 10 years after the date of sale. However, it may in fact be difficult to enforce this provision for firms that have ceased to manufacture. In these circumstances the farmer's only alternative may be to have the repair part made to order by a local machinist. There are, of course, many short-line companies that have been in business for a long time and provide a service to their customers that is as reliable and complete as that of the full-line firms.

This rather varied reliability of the products and service provided by short-line firms was underlined before the Commission in the submission made on behalf of the Farm Equipment Manufacturers Association, an association of short-line manufacturers in North America. The Association, whose membership is largely in the United States, grants the use of its seal of quality to members who meet the following rather limited conditions: have produced and distributed farm equipment for three years; undertake to provide repair parts promptly and at a fair price for a minimum of 10 years after the date of sale; issue a repair parts list and operating instructions manual with new machines, and provide a written warranty.

It was stated that over the years the Association had been able to get about one-half of its members, around 100 companies, to qualify for the seal of quality.[2]

It is clear that some short-line companies may provide farm machinery under conditions and circumstances that would not be tolerated from a major full-line company. They may provide equipment that is not well engineered or adequately tested. They may abandon markets after a few years because they prove unprofitable, leaving the farmer to obtain repair parts as best he can. Warranties may be inadequate and service may be slow. The risk to the Canadian farmer may be particularly severe because of the large number of short-line companies operating in the United States that may at times distribute their product in Canada. In the U.S. *Census of Manufactures* for 1963 it was reported that the farm machinery industry had 1,568 establishments. Nevertheless, it was argued before the Commission that these many small firms should not be required to meet any very rigid standards. Many new innovations come from these small firms, it was contended, and the benefits from the progress obtained in this way was well worth the cost and inconvenience to a few individual farmers.[3] However, some of the farmers who had been inconvenienced in this way were less confident about the beneficial results. There is, in fact, a large element of "let the buyer beware" in many parts of Canada when a farmer buys equipment from small and relatively unknown short-line companies.

In general, competition from short-line companies is strongest either in relatively simple products that do not require extensive engineering and for which an efficient manufacturing operation is fairly small in scale, or in new and relatively specialized products. Often the total market for these products will be somewhat limited, perhaps because they are used in only one particular area or region or in a rather specialized type of farming. Because of these market characteristics, the manufacture of such products is relatively unattractive for a full-line company, which prefers a line of products that can be sold to all of its dealers or at least a major group of dealers. The extent to which full-line companies participate in the manufacture and sale of specialized products varies widely. For example, only three of the full-line firms offer for sale cotton pickers and potato harvesters or diggers.

Competition from short-line firms is supplemented by the competition provided by intermediate-sized companies who produce or sell a long line of equipment but not a full line. There are at least three long-line firms whose sales in Canada exceed $15 million annually. One or two of these firms may be approaching the status of full-line firms since they sell both tractors and combines (although they need not manufacture these themselves). There are a number, perhaps 10 or 12, of additional long-line companies operating in the United States which sell some equipment in the Canadian market. The following brief description of the

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[2] Royal Commission on Farm Machinery, Transcript of Evidence, *Hearings,* Vol. No. 42, January 19, 1968, pp. 4746-49.

[3] *Ibid.*, pp. 4799-4804 and 4817-22.

operations and policies of four firms will serve to illustrate the impact of these long-line companies on competitive conditions in the Canadian market.

Allied Farm Equipment – As of 1968 the Allied Farm Equipment, Inc. had sales of around $23 million (U.S.) of which about 75 per cent were in Canada. It started out as an export sales organization based in Chicago just prior to the Second World War. However, its major growth has been since 1945. Although it regards itself primarily as a marketing organization, it manufactures about 40 per cent of the products it sells. Its major products include front-end loaders, grain augers, bale elevators, harrow drawbars and sections, field sprayers, and tractor cabs.

Allied's success has been based to a large extent on providing a guarantee of stability and reliability of service that many short-line companies are incapable of giving. In his appearance before the Commission, Mr. J. I. Kanter, the President of Allied, described the short-line industry as "a vast fragmented industry consisting of literally hundreds and thousands of small and medium-sized, badly fragmented in many instances, not particularly well organized small manufacturers".[4] In some instances Allied has purchased the entire stock of components and repair parts of a manufacturer who has gone out of business or discontinued a line of equipment that Allied had introduced in Canada. By providing some guarantee that parts and service would be available and by backing up the equipment it sells with warranty provisions, it has helped provide a stable and expanding market for the products of short-line companies. In some degree, also, Allied sees its role as that of "bringing to the Canadian farmer new developments, specialty lines, which have a potential for labour saving and increased efficiency on the farm, bringing them to the Canadian farmer sooner, and in a more meaningful way than they would be otherwise brought to Canada".[5]

The company sells its products through existing dealers and may sell some pieces of equipment to as many as 80 or 90 per cent of the dealers in any one province. Only in the case of more complex types of equipment that require more stocking of parts and specialized service will Allied franchise one particular dealer in a given location. Because many of the products it handles are complementary to, rather than competitive with, the equipment sold by the full-line companies, it has encountered little difficulty in persuading dealers for these latter companies to handle Allied products.

New Holland – The New Holland Division of the Sperry Rand Corporation commenced production of farm machinery in a significant way in 1939 when it acquired the rights to an automatic pick-up baler that had been developed by a local farmer. Since that date it has experienced rapid growth, although it still confines its operations mainly to haying and harvesting and related equipment. In 1967, New Holland was the leading brand in terms of total volume shipped in North

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[4] *Ibid.*, Vol. No. 26, November 1, 1967, p. 2738.
[5] *Ibid.*, p. 2737.

America of a number of products including bale throwers, hay-balers, forage harvesters, hay rakes, hay conditioners, and manure spreaders.

The company attributes a major part of its success to the fact that it has pioneered many new developments designed to reduce the cost of farming operations. For a number of products, including the automatic self-tying baler and the Haybine mower-conditioner, New Holland has been the innovator. For other products it has developed and improved machines introduced by other manufacturers.

This company entered the combine market when it purchased the Clayson factory in Belgium in 1963. It currently exports combines from its Belgian plant throughout Western Europe and to Australia, and ships the basic shell of its combine to North America where other components are added to produce a machine suited to this market. New Holland has also recently constructed plants in France, Britain, and Australia. These plants produce mowers, balers, haybines, manure spreaders, and related products.

In Canada the company distributes its products through its own branch house and dealer organization. About half of its dealers are also dealers for full-line companies who manufacture and sell products directly competitive with those of New Holland. Of the remaining dealers, about two-thirds are exclusive New Holland dealers and the balance handle other short-line manufacturers' products. A number of dealers combine their New Holland line with the David Brown tractor line.

The fact that New Holland has been able to grow to a position of such major importance in a particular sector of the farm machinery market is evidence that new entry to this industry is still possible. Although the New Holland Machine Company started out as a small independent manufacturer, in 1947 it was acquired by The Sperry Corporation. In 1955 Sperry merged with Remington Rand Inc., to become Sperry Rand Corporation, a large multi-product firm with annual sales exceeding $1,500 million (U.S.). Some of New Holland's recent success undoubtedly reflects its access to the management skills and research capability of a large international company.

Versatile - Versatile Manufacturing Ltd. was formed in 1963 as the result of the amalgamation of a number of short-line companies. The principal predecessor company had been formed in 1947 and initially concentrated on the production of sprayers and grain augers. In 1953, for example, the company produced 500 sprayers, 4,500 grain augers, and 500 drawbars. It subsequently added swathers and combines to its product line and in 1966 it began to produce large four-wheel-drive tractors. Its growth has been very rapid, total sales having increased from $9.2 million (Can.) in 1964 to $22.5 million in 1967. This was also a period of very profitable growth, with earnings after tax increasing from $1.2 million in 1964 to $2.8 million in 1967. Although Versatile's sales have continued to expand in the

less buoyant market conditions of recent years, to reach $33.8 million in 1969, its profits declined sharply to $551,000.[6]

Versatile's successful and profitable penetration of the farm machinery market in competition with the large full-line companies appears to have been based on a number of key elements. Thus far it has concentrated almost entirely on products designed to be sold in the Prairie grain-farming area of Canada and the United States. Because of its location on the edge of this market it has been able to ship directly from its factory to dealers and avoid some of the branch-house distribution costs incurred by the full-line firms. Initially it relied on selling products through the existing dealers of other companies, offering them a larger discount from list price than is customary in the trade. However, it has now begun to build up a dealer network of its own. In addition, Versatile has not attempted to carry a full line of sizes and varieties of all the equipment it supplies, but has concentrated on the sizes and types where volume is largest. At the same time, by simplifying its design and building products which emphasize function rather than style or appearance, it has been able to offer its products at a price substantially below those of the full-line companies. Versatile's prices on a given product have often been from 20 to 30 per cent below those of their competitors. Thus the company has catered to farmers who want to buy a cheaper but functionally adequate product. Its lower prices and larger dealer discounts have helped build sales, and to some degree it has avoided the need to build an elaborate dealer network.

C.C.I.L. – Another significant long-line competitor in the farm machinery market in Western Canada is Canadian Co-operative Implements Limited. Formed during the war years, C.C.I.L. began the manufacture and sale of farm machinery in 1946. In its early years it had a contract for the distribution of Cockshutt machinery in competition with regular Cockshutt dealers. In addition, it manufactured some machines in its own small factory in Winnipeg. When Cockshutt was taken over by the White Motor Company in the early sixties, C.C.I.L. was forced to discontinue the distribution of Cockshutt equipment and turned to Europe for its source of combines and tractors. Initially it distributed the Clayson combine, but when New Holland acquired an interest in the Belgian firm that manufactured it, C.C.I.L. was forced to find a new source of combines and began to distribute a combine manufactured by the Claas firm in Germany. Still more recently Ford has begun to distribute Claas-made combines under the Ford name in both Eastern and Western Canada and in the United States. Currently C.C.I.L. imports Deutz tractors from Germany and Volvo tractors and combines from Sweden. Volvo combines are imported as semi-finished machines and completed with tables and grain tanks suitable for western conditions (i.e. pick-up tables instead of tables with cutting parts and a much larger grain tank). Using only the threshing body of the Volvo combine, C.C.I.L. builds its own pull-type combine.

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[6]For its 1969 fiscal year, Versatile changed its year end to October 31 from August 31. These figures, therefore, cover 14 months instead of 12 months.

Starting with an initial subscribed capital of around $750,000 in 1946, the firm expanded until in 1966 it had assets of almost $16 million and annual sales of around $20 million (Can.). Slightly over half of its sales are of machines and parts manufactured in its own plant. In the early years of its operation, C.C.I.L. paid out significant cash dividends to its member customers, varying between 5 and 10 per cent from 1946 to 1952. Since then it has for the most part retained a major part of its earnings to provide for expansion, giving members credit in the form of additional shares. Its total earnings in 1966, before tax, amounted to about 16.8 per cent of its total assets and 13.3 per cent of gross sales (of new machines and parts). The firm currently supplies about 5 per cent of the Prairie market. By 1969, in line with the experience of the industry on the Prairies, C.C.I.L.'s sales had fallen sharply and the firm incurred a loss of $846,000.

One of the firm's principal innovations was the establishment of a rationalized distribution system. Sales and service is provided through 60 depots located at strategic points designed to serve the entire Prairie region. Each depot is provided with a well-equipped service facility and carries a stock of repair parts. C.C.I.L. also pioneered in the development of several new farm implements. It was the first firm to introduce the "disker" and it secured a copyright on that name. It also developed and marketed the "harrower", an improvement on the traditional drag harrow, and a folding harrow drawbar. However, C.C.I.L. has no formal research and development division, relying for new ideas on suggestions or inventions of farmer members or of its regular staff. The role of co-operatives in the industry is discussed further in Chapter 10. A more detailed appraisal of the firm's performance is provided in one of the Commission's special duties.[7]

Other Companies – The operations in Canada of several other companies may be more briefly noted. The Ford Motor Company, the second largest producer of wheeled tractors on a worldwide basis (next to Massey-Ferguson), sells its tractors and a moderate range of other equipment through its dealer organization in Canada. Ford appears to be gradually expanding its line of farm machinery. It has a fairly complete line of haying equipment, recently introduced a line of deep-tillage cultivators in Western Canada, and now sells the Claas-made Ford combine throughout North America. Though it must still be considered a long-line rather than full-line farm machinery organization, it is nevertheless one of the world's industrial giants and could easily extend its range of implements and become a full-line firm. Ford sold about 3,500 tractors in Canada in 1966, between 11 and 12 per cent of the total. It does not manufacture any farm machinery in Canada.

New Idea Farm Equipment is a division of the Avco Corporation which in Canada sells mainly in Ontario. Its chief product emphasis has been on haying and corn-harvesting equipment, but it also sells some barnstead equipment including manure spreaders. One of its major product lines is the Uni-system which it

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[7]R. Simkin, *The Prairie Farm Machinery Co-operative,* Royal Commission on Farm Machinery, Study No. 5 (Ottawa: Queen's Printer, 1970).

acquired from the old Minneapolis-Moline organization in 1963. This features a self-propelled power unit which can be attached to a number of other machines, primarily haying or corn-harvesting machines. It has no manufacturing facilities in Canada.

Two other firms which are significant in the Canadian tractor market are David Brown Tractors Limited and the British Leyland Motor Corporation. Both have Canadian subsidiaries which import a line of smaller horsepower tractors which are sold primarily in the East.

Chapter 5

MAJOR CHARACTERISTICS OF THE MARKET FOR FARM MACHINERY

Farmers' Attitudes and Requirements

To the farmer, farm machinery represents essential capital equipment. When he buys a major piece of equipment he normally excepts it to continue in use for 5, 10 or 20 years either on his own farm or, after resale, on some other farm. If the equipment is to be fully productive it must be kept in good repair and the farmer must be able to have it repaired promptly when it breaks down. Over the past few decades, a number of developments have increased the importance to the farmer of good servicing facilities and repair parts availability as an essential complement to the equipment he buys. With the increased use of hydraulics, advanced types of transmissions, power steering, sensing devices, diesel engines with fuel injection systems, and with the growing sophistication of machinery generally, the farmer is less frequently able to repair his own equipment and so must depend more and more on the service facilities and skilled mechanics supplied by a farm machinery dealer. Further, the use of the combine has made the timing of harvesting operations more critical. Since a farmer may have only 18 or 20 good combining days in a season, it is of extreme importance to him when his machine breaks down that he should be able to obtain any repair parts he needs with a minimum of delay. Timing has either become more critical, or is now recognized to be more critical, at other periods of the year as well. Whether he is preparing the land in the spring, seeding, fertilizing, applying weed killers or insecticides, harvesting a hay crop or performing his summer fallow operations, timing may be of the essence, with a few days' delay resulting in a substantial loss of potential farm income. To some degree the timeliness of farming operations has always been important. But its critical importance now is more fully recognized. And with advances in farming techniques, a larger number of field operations may be carried out and more inputs of various kinds applied. Thus by the time the crop is ready to be harvested the farmer has often invested a large amount in bringing it to that stage. All of these considerations help explain the extreme importance the farmer now attaches to the repair parts and servicing facilities that complement any piece of farm equipment he buys.

This attitude was evident in the results of a survey of farmers carried out on the Commission's behalf in the Prairie Provinces. When questioned about the

various reasons why they patronized a particular dealer, the three reasons farmers singled out as the most important were that (1) the dealer had a reputation for standing behind the machinery he sells, (2) the dealer had a reputation for honesty, and (3) the dealer had a good repair and service department. In contrast, brand loyalty ranked fairly well down the list in terms of the importance attached to it. The complete results for this particular question are given in Table 5.1.

TABLE 5.1 – IMPORTANCE OF VARIOUS REASONS IN INFLUENCING FARM OPERATORS' DECISIONS TO PURCHASE FARM MACHINERY WHERE THEY DO

Reasons	Degree of Importance		
	Very Important	Not Very Important	Unimportant
		(Per cent)	
Dealer has a reputation for standing behind machinery he sells	88	7	5
Dealer has a reputation for honesty	88	8	4
Dealer has a good repair and service department	87	12	1
Dealer gives me a good deal	70	29	1
Dealer doesn't try to force me to buy until I'm ready	54	13	33
Dealer has a complete line of machinery	60	26	14
Dealer is always friendly	60	21	19
Dealer's place of business is easy to get to	70	17	13
Dealer-owned rather than company-owned store	18	18	64
Adequate parking place available close to dealer's place of business	35	18	47
He is the only dealer in my area selling the brand I want	20	27	53
Dealer carries adequate line of farm supplies as well as machinery	40	14	46
Co-operative store rather than company-owned store	28	11	61

Source: A. Segall, *Farmers' Attitudes to Farm Machinery Purchases*, Royal Commission on Farm Machinery, Study No. 4 (Ottawa: Queen's Printer, 1969), Table 21.

When the farmer purchases a piece of equipment he is also normally in the market for the money capital required to finance it. Thus his decision as to how much machinery to buy and from whom to purchase may be influenced by the terms and amount of finance that is available. With the growing size and complexity of farm equipment, the amount of funds required to finance the farmer's investment in machinery has increased manyfold. Some thirty years ago, in 1939, a farmer might have typically been in the market for a small tractor at a cost of $1,500, or a binder at $300 or a threshing machine for $1,200. Today, in 1971, he may find himself buying a large 80 or 100 HP tractor for $10,000 or a self-propelled combine for $12,000. If he is a well-established farmer, he may be able to finance a large part of his purchase by trading in a similar machine which is

only a few years old. Indeed, some farmers may trade in their major pieces of equipment every year in order to minimize the risk of any breakdown in critical periods. But if he is just starting out as a farmer or is expanding his operations, he will often be in the market for a substantial loan to finance his machinery purchases.

The size of the investment a farmer makes in many individual pieces of equipment and the complexity of the machinery he buys has increased his concern about the reliability of the equipment. If a machine breaks down because of some defect in workmanship or material, he wants assurance that its manufacturer will be responsible for restoring it to proper operating condition promptly. This same complexity and size has made the farmer's purchasing decisions more critical. Because he is often investing much larger amounts it becomes more important that he evaluate carefully every piece of machinery he buys as to its suitability for his own farming operations. Yet the increasing pace of change in farm equipment, a product of the much larger amounts that are now being spent on research and development, has made the traditional sources of information on which farmers have based their decisions less reliable. The study of farmer attitudes and behaviour cited above indicates that farmer still rely heavily on talking with friends, neighbours, and relatives or on watching machinery in operation on a neighbour's farm as sources of information on which to base their buying decisions. When asked to rank various sources of information on farm machinery in order of importance, 32 per cent ranked the former as most important and 19 per cent cited the latter. Government agricultural representatives and extension staff were ranked close to the bottom of the list. Regarded as intermediate in importance were articles in farm magazines. Literature supplied by the farm machinery companies and information obtained from implement dealers and salesmen were ranked fairly well down the list (see Table 5.2).

It is worth noting that the source of information that farmers rely on most heavily – talking with friends, neighbours, and relatives – is not an independent source of information about new equipment except to the extent that someone has purchased and used this equipment or has himself obtained information from some other source. Thus, as model changes become more frequent and the pace of technical advance in farm machinery accelerates, farmers will be forced to resort increasingly to other sources of information. To some degree, the concern expressed by farm organizations about the frequency of model changes and the importance of an independent testing agency may reflect a recognition that the traditional sources of information are no longer adequate. In the survey below, although some 62 per cent of farmers expressed satisfaction with their existing sources of information, about one-third felt additional information was needed. When asked to enlarge on their views, the most frequently cited suggestion was for additional information provided by an independent testing agency.

TABLE 5.2 – EXTENT TO WHICH VARIOUS SOURCES OF INFORMATION ABOUT FARM MACHINERY ARE UTILIZED BY FARM OPERATORS

	Ranked as Most Important	Extent Used		
		Frequently	Now and Then	Seldom or Never
	(Percentage)		(Per cent)	
Articles in farm magazines	10	35	47	18
Machinery company literature	5	18	45	37
Talking with implement dealers and salesmen	8	15	38	47
Watching machinery demonstrations at farms	13	17	33	50
Talking with friends, neighbours and relatives	19	62	27	11
Agricultural representatives	5	11	23	66
Radio and T.V. programs	2	19	39	42
Articles in newspapers	5	25	55	20
Advertising	1	12	38	50
Agricultural extension staff	0	2	30	68
Watching machinery in operation on neighbour's farm	32	55	30	15

Source: A. Segall, *Farmers' Attitudes to Farm Machinery Purchases*, Royal Commission on Farm Machinery, Study No. 4 (Ottawa: Queen's Printer, 1969), Tables 9 and 10.

The survey also attempted to assess the basis on which farmers make their machinery investment decisions. Although the study is far from conclusive, it suggests that most farmers have no very specific method for determining how much machinery they need. Concerning their most recent purchase, farmers cited, as the most important reasons affecting their decisions, that (1) they wanted a larger model in order to get the job done on time, (2) the old unit was wearing out and giving considerable trouble, (3) they wanted a larger model in order to make better use of available labour, (4) they needed a new machine and their economic situation had improved so they could afford it, and (5) they wanted a newer model because of the big improvements made over the one they owned. The 11 reasons that farmers were asked to rate are given in Table 5.3. In general, the shift to larger units as farming operations expanded, or because timing of operations required more power, emerge as the most important reasons affecting farmers' purchases of new equipment.

Existing farms vary widely in size, location, type of soil, and kind of farming activity. This creates a demand for a wide variety of different sizes and types of equipment. In some areas, farmers are engaged primarily in row crops such as corn or sugar beets and their demand is for a tractor suited to this type of farming. In other areas, the main crop is wheat or coarse grain which is grown in large fields.

The land may be flat in some areas and hilly in others. Soil varies widely in its texture and workability. Climatic conditions, too, vary greatly in different parts of Canada. On the Prairies and especially in northern regions, the growing season is very short and the risk of early frosts affects the kind of crop that may be grown and the type of harvesting equipment used. In contrast, in the Atlantic region, rainfall is heavier than on the Prairies, and the combine used must be able to handle more straw and green material.

TABLE 5.3 – IMPORTANCE OF VARIOUS REASONS IN INFLUENCING FARM OPERATORS' DECISIONS TO PURCHASE MOST RECENT UNIT OF FARM MACHINERY

(Percentage)

	Degree of Importance		
Reasons	Very Important	Not Very Important	Unimportant
Old unit was wearing out and giving considerable trouble	56	13	31
Wanted a newer model because of the big improvements made over the one owned	42	18	40
Have increased size of farming operation and needed a larger model (more power)	40	11	49
Not satisfied with brand owned, felt a different brand would do a better job	22	11	67
Have needed a new one and situation improved so could afford it	46	14	40
Dealer made such a good offer I thought I better take it	34	11	55
Owning a full line of well-kept machinery	34	6	60
It is just good business to keep up to date in machinery	39	15	46
Wanted a larger model in order to get job done on time	70	13	17
Wanted a larger model in order to make better use of available labour	50	12	38
Decided not to hire machine-work any longer	16	4	80

Source: A. Segall, *Farmers' Attitudes to Farm Machinery Purchases*, Royal Commission on Farm Machinery, Study No. 4 (Ottawa: Queen's Printer, 1969), Table 20.

Farmers also differ in the extent to which they want their machines to be comfortable and easy to handle. This is not just a matter of comfort. When the machine operator is protected from noise and heat, he will tire less quickly and may not only be able to work a longer day, but can guide his machine more accurately and effectively when he is using it. Where timing of farm operations is critical and seasonal labour supplies are scarce, the increased work made possible by air-conditioned cabs, power steering and similar features of the newer farm machines may fully justify their extra cost.

FIGURE 5.1—ANNUAL SALES OF SELECTED FARM MACHINES, CANADA, 1948-68

SOURCE: DOMINION BUREAU OF STATISTICS FARM IMPLEMENT AND EQUIPMENT SALES, VARIOUS YEARS, CAT. NO. 63-203 (OTTAWA: QUEEN'S PRINTER).

Because of the fluctuations that occur from year to year in the size of his crop, the farmer normally prefers to defer his purchase of a major piece of equipment until shortly before he expects to use it. This is particularly true of harvesting equipment. If the crop is light and easy to harvest he may decide to make his existing equipment last another year. This means that purchases of machinery are rather heavily concentrated in the spring and summer months. During recent years about 85 per cent of all new machines have been sold during the seven months from April to October. For some farm machines, particularly newer types of equipment, sales may rise quickly during the period when the machine is being adopted and then fall back to a replacement level. Changes in the pattern of demand for a number of machines for Canada are illustrated in Figure 5.1. If the machine is an important one, the various machinery companies will be under strong pressure to have a competitive model of this machine in the market at the right time.

Finally, it should be noted that in a period when the rate of technical change is increasing, farmers face a higher risk of obsolescence on their equipment. Farmers may attempt to minimize this risk and the uncertainty associated with it by trading in their major pieces of equipment frequently; this is probably one of the major reasons why the trade-in and the second-hand market has become characteristic of the industry. Thus the rapid trend towards larger tractors, which has made it possible for one operator to manage a larger farm, has also created a demand for larger equipment of all types to complement the larger power unit. To the farmer moving to a larger tractor and larger acreages, much of his existing equipment may no longer be suitable and may have to be traded for larger units. His ability to make such trades and the cost to him of doing so will depend on the strength and effectiveness of the second-hand market for machinery.

Recent Changes in Product Line and Distribution Policy

The farm machinery companies have responded to this changing pattern of farm demand in a number of ways. Shortly after the Second World War they shifted from selling through commission agents to a system of selling through independent dealers. The independent dealer system has proven a much more satisfactory method of handling sales involving trade-ins, and of providing the service and repair parts required on modern farm equipment. The quality of the service provided to the farmer, however, is critically dependent on the capability of the dealer, as all the companies have gradually come to recognize. This recognition has been reflected in policies designed to eliminate the weaker dealers and to improve the quality of the service provided by the remainder. The result has been a very marked reduction in the number of dealers during the past two decades. All of the major companies place a major emphasis on recruiting competent dealers. In addition, many of them provide their dealers with a variety of facilities and aids to help them give good service to the farmer. These facilities and aids include special instructional courses for dealer mechanics and parts men, repair manuals, guides as to suitable

dealer premises and repair-parts stocking, special discounts to induce stocking of parts in advance of the season of use, and some assistance in dealer financing. All of these changes will be described in detail in subsequent chapters.

An alternative to the independent dealership system would have been company-operated sales and service establishments. The major companies have established such facilities in locations where they have been unable to find a suitable independent dealer. However, they have invariably found the company-owned store a less satisfactory basis of operation. This may be partly due to the fact that salaried employees do not work as hard or show as much initiative as independent businessmen, and partly because sales involving trade-ins can easily become the source of considerable loss when they are handled by an employee. The experience of Canadian Co-operative Implements Limited with their depot system has been similar. C.C.I.L. has admitted that their depots are not as efficiently operated as the independent dealerships.

Because of the increasing cost of many farm machines, a reflection of their increasing size and complexity as well as rising prices, many companies finance sales of their equipment at both the dealer and farm level. When the dealership system was first introduced in Canada at the end of the war, dealer financing was not a significant problem because farm machinery was in short supply and most machines moved directly into some farmer's hands as soon as they reached the dealership. However, about a decade later, when the backlog of demand had been largely eliminated, the farm machinery companies found it necessary to assist their dealers financially if they were to be induced to keep an adequate stock of the company's machines on their premises. Accordingly, the practice of "floor planning" machines in the dealers' hands on an interest-free basis became general in the industry. At the war's end, too, financing the farmer's purchases was not a significant problem. Many farmers had accumulated funds in the form of bonds or bank deposits which could be drawn upon to purchase new machinery, and for those who needed to borrow, the newly adopted Farm Improvement Loans Act (F.I.L.A.) was available to facilitate their access to funds. In time, however, these sources became insufficient to meet all requirements for funds and a number of companies found it desirable to introduce finance plans of their own to help them compete more effectively for the farmer's business. There has also been a growth of special inducements for the farmer to buy well in advance of his normal period of use. These developments are described in some detail in later chapters.

In recent years competition among companies has also taken the form of offering an increasing number of options and sizes on various machines. For example, International Harvester reported that a farmer now can buy from them a combine in 11 different cutting widths. Moreover, a selection of 2-, 3-, 4-, and 6-row corn heads is available to increase the machine's versatility. The same company offers 7 different hay-balers, 9 different mowers and 3 hay conditioners. This development has been comparatively recent. International Harvester reported that a dozen years ago they marketed in Canada only 11 different models of

tractors, 4 combines, and 3 different hay-balers. Now they offer 32 tractors, 8 combines, and 7 hay-balers. There has also been a strong trend in recent years towards providing more comfort and convenience on farm machines. Included are sophisticated hydraulic systems that enable the tractor operator to preset his ground-working tools and maintain them precisely at that depth. He may be provided with sensors that detect changes in terrain and soil conditions and automatically adjust for them. He may obtain power steering, power brakes, and a number of advanced types of transmissions. He may purchase cabs for his combine and tractor that are complete with windshield wipers, tinted glass, and air conditioning. Many of these items are furnished as options which the farmer does not have to buy. But there is a tendency for today's option to become a standard part of tomorrow's machine.

This trend towards more types and sizes of equipment and an increasing number of options reflects in part the research and development that all major companies now carry out. Continuous R&D has become a major concern of any farm machinery company that wants to remain fully competitive in the farm machinery market. A few companies have recently set up research units concerned with pure or advanced research in areas related to the use of farm machinery. This competitive aspect of research and development is examined in some detail below. In some measure also, the emphasis on the number of types and sizes of machines and on many different options is a reflection of the industry's emphasis on non-price forms of competition. This characteristic of the industry will also receive further attention in a later chapter.

Variety and Volume of Major Products

Not only have existing machines become larger, more sophisticated, and available with more options and a larger range of sizes, but there has also been a very considerable increase in the number of different kinds of machines on the market. Some of these newer machines reflect advances in agricultural methods which have resulted in much greater use of fertilizers, insecticides, herbicides, and other products requiring special machines to apply them. Others reflect the strong incentive to create more labour-saving methods of performing traditional farm jobs. Often demand may shift quickly from one product to a new substitute. In addition, the machines – like the farms – have become larger and fewer in number. Both the variety of machines and the decline in numbers have important implications for production costs. The industry has tended to lose economies in scale and move in the direction of the custom-made product.

Some indication of the current relative importance of different products and of some of the changes that have occurred over the past two decades is provided by Table 5.4. In 1967, wheeled tractors accounted for just over one-third of the wholesale dollar value of total sales. In order of importance tractors were followed by combines (15.1 per cent), swathers (5.8 per cent), hay-balers (3.6 per cent), field cultivators (3.6 per cent), and diskers (2.0 per cent).

TABLE 5.4 – SALES OF FARM MACHINERY, CANADA, MAJOR MACHINES, 1949 AND 1967

(Value at wholesale, Canadian dollars)

	1949	1967	
	No.	No.	($'000)
Tractors, wheel type, farm	62,205	29,814	147,612
9–34 HP		1,148	2,756
35–39 HP		6,936	19,674
40–49 HP		2,824	9,903
50–59 HP		4,516	19,700
60–79 HP		5,477	30,264
80 HP and over		8,903	65,314
Combines			
Pull-type	6,239	2,307	10,685
Self-propelled	5,746	6,464	54,801
Swathers and windrowers			
Pull-type	7,926	5,333	7,030
Self-propelled		6,722	17,880
Automatic hay-balers	1,914	9,761	15,605
Field cultivators	19,987	19,540	15,749
Diskers	8,894[1]	5,599	8,550
Tractor loaders	2,398	13,216	6,385
Disk harrows	24,393	9,110	6,316
Manure spreaders	9,904	7,836	6,188
Rod weeders	2,431	3,734	2,801
Grain augers	n.a.	18,162	3,055
Moldboard plows	15,453	10,624	5,855
Barn equipment			12,775
Dairy equipment			9,006
Farm wagons, boxes and sleighs			5,772
Field sprayers		8,156	3,060
Mowers		7,218	3,161
All other machinery			90,013
Repair parts			61,999
Total machinery and parts			494,298

[1]Data are for 1952; n.a. for 1949.

Source: Dominion Bureau of Statistics, *Farm Implement and Equipment Sales,* Cat. No. 63-203, 1949 and 1967.

The changing nature of the market is also evident. Although the number of tractors sold declined by one-half between 1949 and 1967, the average size of tractors sold increased from 19 HP to 63 HP. In terms of value, 85 per cent of the market in 1967 was in the size range above 39 HP, a range in which sales were only minimal in 1949 and only 23 per cent as late as 1957. Further, almost 80 per cent of the tractors sold in 1967 had diesel engines. In 1949 tractors were almost entirely powered by gasoline engines. The number of moldboard plows sold declined by about one-third between 1949 and 1967. In contrast with the decline in numbers for tractors and plows has been the growth in the baler market from less than 2,000 in 1949 to almost 10,000 in

1967. Similarly, sales of tractor loaders have increased from around 2,400 in 1949 to over 13,000 in 1967. The table also shows quite clearly the comparatively small volume in the Canadian market for all machines. For most products Canadian sales are fewer than 10,000 units and this often includes a wide variety of types and sizes.

Sales of farm machinery in Canada are, of course, only a fraction (in recent years about one-sixth) of sales in the large immediately adjacent market in the United States. All the major firms treat the entire area as a single market. Thus the total North American market will usually offer a total volume some seven or eight times that of the Canadian market alone. Data on total sales in the United States are not available but the value of shipments to the domestic market by U.S. manufacturers of farm machinery amounted to some $2.6 billion in 1966 (see Table 5.5). Market changes in terms of numbers, types, and varieties of machines sold have perhaps been even more marked in the United States than they have in Canada. For example, the number of corn pickers manufactured in the United States declined from about 41,000 in 1957 to just over 13,000 in 1966. Meanwhile, the output of corn heads for combines increased from around 5,000 in 1957 to over 25,000 in 1966. Or again, output of silo unloaders rose from 4,000 in 1957 to 24,000 in 1966 and output of field forage harvesters increased from 14,000 in 1957 to 30,000 in 1966. In this same period output of pick-up balers declined from 68,000 to 49,000 and output of manure spreaders declined from 58,000 to 38,000. Output of hay conditioners fell from 52,000 in 1959 to 11,000 in 1966. These marked changes in the demand for different products over a comparatively few years underline the need that manufacturers have to respond quickly to changing market conditions (see Figure 5.2).

It is evident that total North American output of farm machinery is relatively small when compared with an industry such as automobiles, which has an output in the range of seven to nine million units annually. In 1967 total wheeled-tractor production in North America was 242,000 units, combine production was around 60,000, hay-baler output was just over 50,000, swather production was around 22,000, tractor loaders about 48,000, manure spreaders 47,000, and rod weeders under 6,000. Larger-volume items were disk harrows with output of around 130,000, moldboard plows with output of 107,000, and cultivators with output around 170,000. However, both cultivators and plows include a wide variety of types and sizes. In any comparative sense, it is clear that this is an industry characterized by a relatively small volume of output.

Continental and Worldwide Market

With the removal of the Canadian tariff in 1944, competition between farm machinery companies in the Canadian market became, to an increasing degree, just one aspect of their competition in the North American market as a whole. Prior to

TABLE 5.5 SHIPMENTS OF FARM MACHINERY FOR DOMESTIC USE, UNITED STATES, 1966

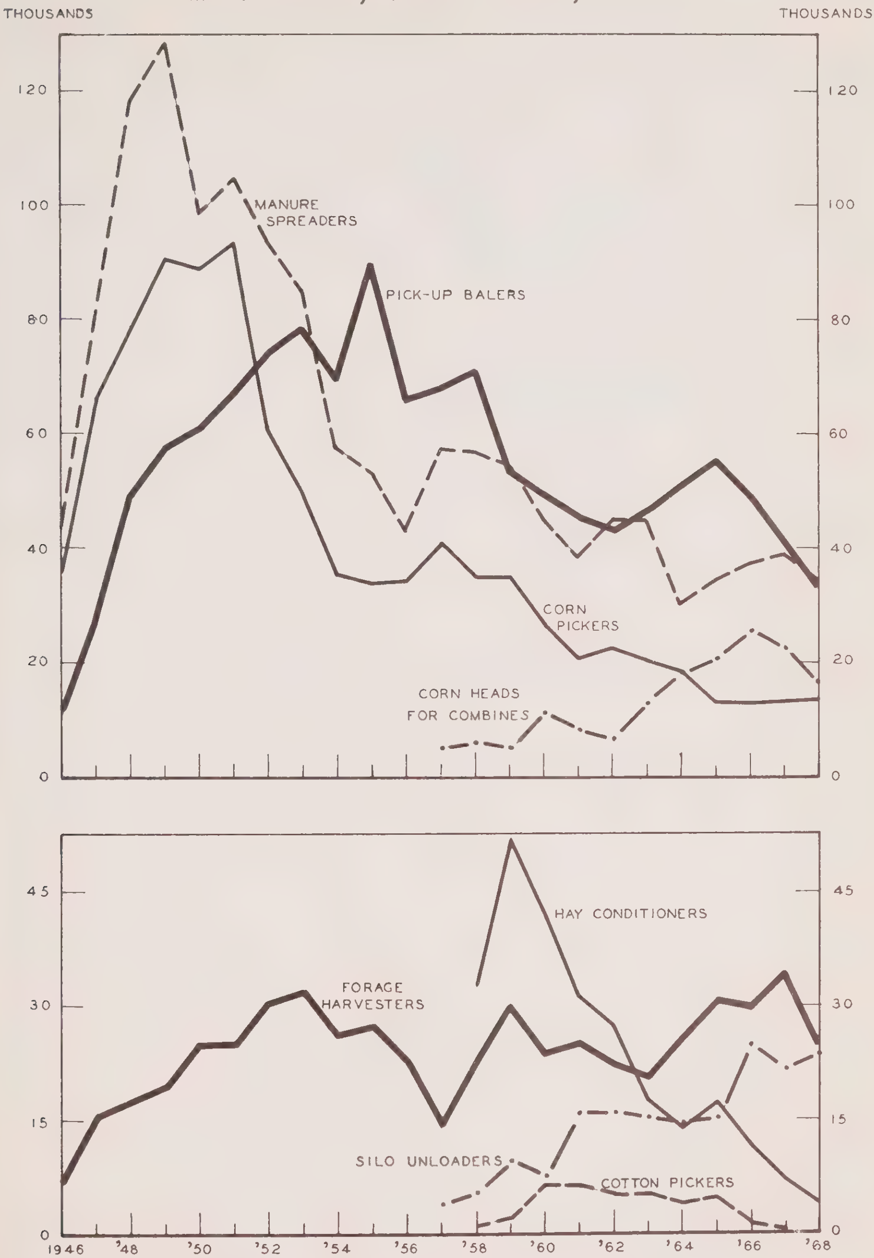
(Value at wholesale, U.S. dollars)

Product	Number	Value
	('000)	($ million)
Tractors		
Under 39 HP	39.6	95.8
40–59 HP	49.6	155.4
60–89 HP	48.4	198.4
90–99 HP	44.8	221.3
100 HP and over	14.7	95.0
Misc. and other	n.a.	157.6
Total tractors	197.2	923.7
Harvesting machinery		
Combines	40.0	273.5
Swathers	6.7	17.0
Other	n.a.	223.3
Haying machinery		
Mowers	46.9	17.0
Rakes	39.6	14.7
Hay-balers	42.9	62.4
Tilling, cultivating and weeding machinery		
Harrows	106.9	71.7
Field cultivators	28.3	11.0
Plows		
Moldboard	104.8	55.4
Other	n.a.	47.1
Planting, seeding and fertilizing equipment		
Manure spreaders	33.8	25.5
Other	n.a.	123.5
Farm dairy machinery and equipment	n.a.	25.5
All other	n.a.	732.5
Total		2,623.8

Source: Based on D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 2.2.

that date, the Canadian market appears to have received separate treatment. Many of the major companies such as International Harvester and Deere used their Canadian plants to supply Canadian and some export markets, supplementing their Canadian production with machinery produced in the United States. Others such as Case and Allis-Chalmers supplied the Canadian market entirely from their American factories. In either case, given the protection provided by the tariff during this

FIGURE 5.2-NUMBER OF UNITS OF SELECTED FARM MACHINES MANUFACTURED, UNITED STATES, 1946-68



SOURCE: U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS, SERIES MA-35A CURRENT INDUSTRIAL REPORTS, FARM MACHINERY AND EQUIPMENT, VARIOUS YEARS.

period, prices in Canada at times followed a different pattern than those in the United States.

With the creation of a common market for farm machinery covering Canada and the United States, all the major companies converted their Canadian manufacturing operations to a more specialized basis, producing certain products for the entire North American market and, to some degree, for overseas markets as well. Most companies now price their products on a uniform basis f.o.b. the point of origin. While this is the general pattern, there are still some pricing differences between the two markets. For tractors these differences were described in some detail in the Commission's *Special Report on Prices.* For the most part any pricing differences between Canada and the United States appear to reflect the somewhat different impact of European imports on the two markets. Ford, for example, markets tractors in Canada that are imported fully assembled from Europe. In the United States it markets tractors assembled in Detroit from components produced primarily in Europe. Massey-Ferguson also reported that parts supplied from Racine, their North American parts headquarters, are priced on a uniform basis in terms of U.S. dollars, but they do not add the full exchange difference[1] when parts are supplied to Canada. There were apparently also differences in the way the exchange differential was treated by various companies during the period from 1951 to 1962 when the Canadian exchange rate was fluctuating on the market.

Some six major full-line companies have established franchised dealers and sell their product line throughout most of the Canadian and American markets. Additional competition is provided by long-line and short-line companies. Although this competition differs to some degree between Canada and the United States, the extent of the difference cannot be easily measured. C.C.I.L. in Western Canada and Coopérative Fédérée de Québec provide an additional competitive influence that is not present in the American market. On the other hand there are many short-line companies in the United States that are not represented in Canada at all, or whose products are distributed in only a few regions.

Thus the pattern of competition in the Canadian market is just one part of the competitive pattern that exists in the larger North American market. Also, a number of major companies such as Massey-Ferguson, Deere, International Harvester, and Ford, find themselves competing against one another in a large number of different markets, and their pricing policies and other competitive practices in North America may be viewed as just one element in a worldwide strategy of competition. During recent years, Massey-Ferguson has been making a major effort to increase its market penetration in the United States. At the same time, Deere & Company has been attempting to expand its market position outside North America and reportedly lost about $18 million on overseas sales of $145 million during 1965. The reaction of each of these companies to the competitive efforts of the other may well be planned on a worldwide basis. Thus each may be

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[1] **Based on the Canadian dollar being pegged at the time at .925 (U.S.).**

prepared to accept an expansion in the market position of the other which it might not accept without some stronger retaliatory steps if each market were considered in isolation.

So far, competition in the North American market from machinery imported from Western Europe has been rather limited. David Brown Tractors Limited and British Leyland Motor Corporation, two British firms, sell a range of smaller horsepower tractors, primarily in the eastern half of the continent. In addition, the Renault and Deutz tractors and Volvo tractors and combines are sold in Canada by co-operatives, the first by Coopérative Fédérée de Québec and the latter two brands, as noted earlier, by C.C.I.L. in Western Canada. A number of the major North American companies also market some tractors and combines made by or for them in Western Europe.

TABLE 5.6 – ESTIMATED PRODUCTION OF TRACTORS AND OTHER FARM MACHINERY, NORTH AMERICA AND WESTERN EUROPE, 1965

(Millions of U.S. dollars)

	Tractors	Other Farm Machinery	All Farm Machinery
Western Europe	1,278	1,507	2,785
North America	1,384	1,630	3,014
Total	2,662	3,137	5,799

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 2.6.

Some indication of the relative importance of farm machinery production in North America and Western Europe is provided by the data in Table 5.6.

Chapter 6

EASE OF ENTRY AND THE CHARACTERISTICS OF DEMAND

Ease of entry for new firms is one of the conditions required for effective competition. When new firms can enter an industry easily, there is a tendency for prices to be driven down towards costs (per unit), for excess profits to be eliminated, and for inefficiency to disappear. This chapter and the following one explore the conditions of entry to the farm machinery industry. The focus in this chapter is on the features of demand that affect entry. The next chapter explores the cost side of the entry problem.

While the entry of a new firm into an industry is often thought of in terms of a small firm starting to manufacture and sell for the first time, many different types of entry may occur in the farm machinery industry. In particular, a short-line firm which has been successfully producing a limited range of products for some time may decide to extend its product line and become a long-line or full-line company. Versatile Manufacturing would fall into this category. A well-established short-line firm may be purchased by a large multi-product firm or conglomerate. Its new owner provides financial backing, management skills, and in some instances access to research facilities, and then expands the firm by introducing new product lines and acquiring other successful short-line firms. The New Holland Division of Sperry Rand Corporation and the New Idea Division of the Avco Corporation fall into this category. Well-established firms in fields involving a related technology, such as automobiles or trucks, may begin to produce tractors and then gradually extend their manufacturing operations until they become a full-line firm. Again the parent company can provide financial backing and access to research, management and marketing skills. The Implement and Tractor Division of the Ford Motor Company is an example of this kind of entry. Fiat in Italy, Renault in France, and the British Leyland Motor Corporation in Britain are examples of automobile manufacturers who have begun to produce tractors but have not yet extended their operations to other types of farm machinery. Still another type of entry is illustrated by the experience of Canadian Co-operative Implements Limited (C.C.I.L.). Here, a newly organized co-operative purchased a small short-line farm machinery plant and gradually expanded its manufacturing and distribution facilities. With distribution facilities

established, C.C.I.L. could provide a marketing outlet for the products of manufacturers in other countries. Its sale of the Clayson, Claas, and Volvo combines, and the Deutz and Volvo tractors are examples of this.

In the following discussion emphasis will be placed on the difficulties faced by a small firm that starts with a single product or limited range of products, and wishes to expand into a full-line firm. It will be clear that many of these disadvantages do not apply where entry is supported by the resources of a large and successful corporation in some completely different or related field.

Several different characteristics of demand will be explored. These include seasonality of demand, its stability from year to year, the long-run growth rate of demand, changes in the size and type of product purchased, the variety of sizes and models of the various products that are in demand, and the number and sophistication of the buyers. Some attention will also be given to the need for distribution facilities that arises when a manufacturer sells over a large area and in regions with different characteristics. The requirement for distribution facilities is also affected by the fact that farm machines need servicing, require repair parts, and usually carry a warranty.

Seasonal Nature of Demand

Demand for farm machinery – and especially the demand for particular machines – is highly seasonal and in any small region fluctuates from year to year. Both features discourage the entry and growth of relatively small firms. A large firm, manufacturing and selling many different products, can keep its labour force and production facilities fully employed, and thus keep its costs per unit down. In this way the larger firm avoids the high inventory costs faced by a firm producing a single product on a year-round basis. Similarly, a firm selling in different regions with different seasonal peaks of demand can spread its output of each product over a longer period, and can reduce the risk associated with erratic year-to-year demand fluctuations that often affect particular areas. This spreading of risk reaches a peak in the larger international companies which sometimes supply markets around the world from a single plant.

The seasonality of demand for farm machinery is shown in Table 6.1. In Canada, a very large proportion of the sales of many farm machines occurs within a three-month period. During the three-year period 1965-67, 91 per cent of all combines, 81 per cent of all swathers, 78 per cent of all diskers, and 72 per cent of all hay-balers, were sold in the three consecutive months of maximum sales for each product. Though significantly lower, the maximum three-month sales for tractors at 44 per cent and cultivators at 50 per cent were still higher than for automobiles. This high seasonality of demand for farm machinery reflects the fact that the farmer usually waits until the season of use is at hand before he buys a new machine. Thus machines must be produced in advance and stocked at convenient locations to meet such demand. Since farm

TABLE 6.1 – SEASONALITY OF RETAIL SALES OF FARM MACHINERY IN COMPARISON WITH RETAIL SALES OF MOTOR VEHICLES (AVERAGES 1965-67, CANADA)

(Percentages of total annual sales in physical units sold in individual months)

	Tractors	Combines	Hay-balers	Diskers	Cultivators	Swathers	New Motor Vehicles
January	2.4	0.8	0.8	0.7	1.0	0.2	6.8
February	3.0	0.9	0.6	0.8	1.1	0.4	6.9
March	5.3	1.7	0.9	1.9	2.0	0.5	10.4
April	12.7	1.1	1.2	11.7	11.1	0.6	10.1
May	16.3	1.0	1.5	45.7	20.9	0.7	10.7
June	10.6	1.3	6.6	16.1	14.1	3.1	10.2
July	6.3	3.3	33.4	3.9	8.0	11.8	7.3
August	6.3	27.5	26.6	3.6	7.2	38.8	6.8
September	7.9	34.2	12.5	2.8	8.7	28.9	5.7
October[1]	21.6	23.7	12.3	10.8	20.9	13.2	8.3
November	4.0	2.6	2.2	1.0	2.9	1.0	8.7
December	3.6	1.9	1.4	1.0	2.1	0.8	8.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1]October data for farm machinery are believed to contain sales made in earlier months.

Source: Dominion Bureau of Statistics, Special Statement, *Farm Implement Sales,* Nos. 6423-519, December 1965; 6403-510, December 1966; and 6403-510, December 1967.

DBS, *Annual Supplement to the Canadian Statistical Review 1967,* Cat. No. 11-206.

machinery dealers are typically unable to finance any substantial inventory of machines, the farm machinery companies must make arrangements to finance the build-up in inventory. The large firm with well-established financial connections will accomplish this more easily than the small new entrant.

Year-to-Year Fluctuations

The year-to-year instability of demand for farm machinery in particular regions reflects agriculture's dependence on weather conditions and to some degree the sharp variations that can occur in prices and in the longer-run market outlook. Farm machinery is a durable asset. Many machines remain in use for 10 to 20 years. Thus a substantial part of the demand for new machines is for the replacement of older equipment. But the exact timing of replacement can easily be varied by a few years, if the crop outlook is unfavourable, or if prices of farm products are low. The instability of farm machinery sales is indicated in Figure 6.1. The sensitivity of farm machinery sales to variations in farm income is discussed in Chapter 19.

When demand drops sharply between one year and the next, the farm machinery companies may be faced with a substantial carry-over of machines. If many of these machines have already been sold to dealers, special arrangements may be necessary to enable the dealers to carry them over to another season. Again, the larger firm will be in a better position to finance this carry-over. Moreover, for the larger firm selling in many different regions, the proportion of total sales affected by this sharp drop is likely to be much smaller than for the small firm selling in a single region or area. Although transport costs will keep many machines from being moved long distances once they are on the dealers' premises, the larger firms, by keeping some machines in central locations, can divert them to areas where demand is strongest, thus minimizing their carry-over.[1]

Slow Long-Term Growth

If the total market for an industry is growing rapidly, it will be easier for a new firm to obtain a foothold and secure a share of this market. In contrast, if the longer-term growth in demand is slow or declining, competition from the older established firms, with ample capacity to meet the market's requirements, will make entry for a new firm difficult. In the farm machinery field, the total market is not only growing slowly in terms of the total value of production, but it is also actually declining in terms of the number of units sold. For example, in 1956 wholesale prices, the total value of farm machinery sold in Canada (excluding repair parts), increased from \$277 million in 1950 to \$298 million in 1966, an increase of only 7.5 per cent in 16 years. As Figure 6.1 shows, both

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[1] Additional evidence on the fluctuations in demand in different parts of North America and for different types of machine is given in D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Ch. 3.

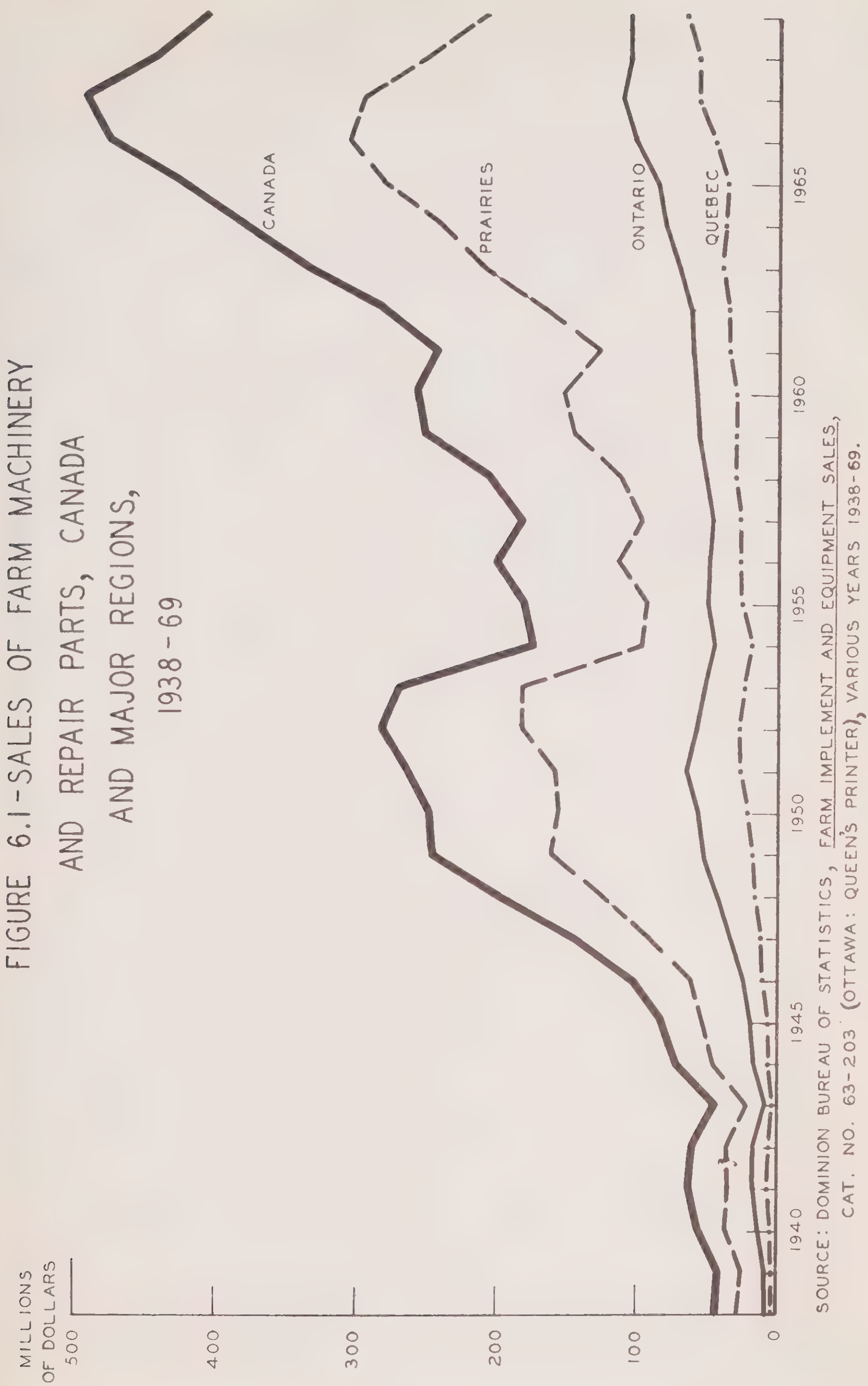

FIGURE 6.1–SALES OF FARM MACHINERY AND REPAIR PARTS, CANADA AND MAJOR REGIONS, 1938–69

SOURCE: DOMINION BUREAU OF STATISTICS, FARM IMPLEMENT AND EQUIPMENT SALES, CAT. NO. 63-203 (OTTAWA: QUEEN'S PRINTER), VARIOUS YEARS 1938-69.

years are near the peak of periods of buoyant machinery sales. Moreover, for a lengthy period between these peak years sales were severely depressed. For the nine years from 1954 to 1962, annual sales (again in 1956 prices) averaged only $165 million, and in all except two of these years sales were within 10 per cent of this average. Such a long period of depressed sales would not encourage new firms to enter the market. In contrast, the two periods of buoyant sales – 1945 to 1953, and 1963 to 1968 – were much more favourable to the entry of new firms. C.C.I.L. got established during the earlier period. Much of Versatile's rapid growth and its development from a short-line to a long-line firm occurred in the later period.

The decline in number of units for particular machines is illustrated by tractor sales. In 1950 there were almost 56,000 tractors sold in Canada. By 1967 the number sold had fallen to just under 30,000. Yet the total horsepower of the tractors sold had increased from about 1.1 million horsepower in 1950 to 1.9 million in 1967. The pattern has been similar in the United States. In the case of combines, in 1950 only 12 per cent of the combines produced in the United States had headers of 16 feet or larger, but by 1960 over 50 per cent were in this class. The rapid increase in the average size of farms, itself a reflection of changes in farm machinery technology, has shifted demand towards a smaller number of much larger machines. For example, the number of grain combines on U.S. farms declined from 1,015,000 in 1957 to 870,000 in 1968. This decline in numbers creates cost difficulties for the new entrant, which will be examined in the next chapter. However, the changes in farm machinery technology which it reflects may create new opportunities for smaller firms.

Even on a worldwide basis (excluding Communist countries) the tractor industry has experienced little growth in the number of tractors produced over the postwar period. As Table 6.2 shows, tractor sales in 1966 at 725,000 units were about 50,000 units lower than in the previous peak year of 1951. In the United States the number of tractors produced declined by about one-half during this same period. A forecast of output for 1970 prepared in 1967 by a major producer, Ford, projected no further growth in unit world sales. This clearly is not the kind of market that encourages the entry of new firms.

Additional evidence of the limited growth prospects for farm machinery in North America is provided by the recent trend among major firms towards the production of other products. Both Deere and Massey-Ferguson have been increasing their output of light industrial equipment and lawn and garden tractors. Massey-Ferguson has begun to move into the heavy construction machinery field, and has also added a snowmobile to its line. Further evidence on the growth prospects in the demand for farm machinery is provided in Chapter 19 and in two of the studies the Commission is publishing separately.[2]

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[2]H. G. Scott and D. J. Smyth, *Demand for Farm Machinery – Western Europe*, Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), and D. Schwartzman, *op. cit.*

TABLE 6.2 – ANNUAL SALES OF TRACTORS, BY COUNTRY, 1950-66, WITH A FORECAST FOR 1970

(Thousands of units)

	Canada	U.S.	U.K.	Other Europe	Latin America	Other Areas	Total Non-Communist World
1950	54	400	36	187	25	11	713
1951	50	437	32	195	37	26	777
1952	44	363	30	203	29	26	695
1953	39	342	31	198	19	58	687
1954	26	225	32	204	32	82	601
1955	26	275	35	253	29	125	743
1956	25	215	28	290	28	39	625
1957	23	202	36	285	31	94	671
1958	23	223	46	270	34	91	687
1959	28	222	41	269	28	148	736
1960	27	190	39	261	33	72	622
1961	25	177	42	279	36	73	632
1962	25	183	38	259	35	80	620
1963	28	186	41	266	38	106	665
1964	29	192	36	274	47	107	685
1965	28	200	35	269	43	102	677
1966	32	227	38	276	37	115	725
				Forecast			
1970	30	190	39	270	49	118	696

Source: Ford Motor Company of Canada, Limited, *Tractor and Equipment Operations*, Brief to the Royal Commission on Farm Machinery, Ottawa, November 16, 1967, Table I.

The fact that the farm machinery industry has faced continuous and even rapid changes in technology creates both opportunities and difficulties for the new entrant. To the important extent that many of the innovations in the industry still originate with individual farmers, the small firm or the new entrant who takes up and exploits one of these new ideas may find entry much easier than it would in an industry with a static technology. C.C.I.L. was the first firm to manufacture the disker on a commercial basis and still has a significant share of that market; it was one of the products that helped to establish C.C.I.L. New Holland owes much of its growth to its role in pioneering new labour-saving machines for the harvesting and handling of hay. During the Commission's hearings executives of that firm claimed that a smaller firm can respond more quickly to new opportunities for new product developments than a large established firm. New Idea's entrance into the farm machinery business is literally based on a new idea, that of having a single power unit that can be attached to a number of different implements so that each becomes, in effect, self-propelled. Versatile's entrance into the tractor market is based on the design of a four-wheel-drive tractor suited to the needs of many large Prairie farms.

On the other hand, to the degree that machinery is becoming more sophisticated and complex with hydraulic units, sensing mechanisms and hydrostatic transmissions, the larger firm with a substantial research and development operation may have a significant advantage. However, this factor should not be over-emphasized. Even as late is 1953, as large a firm as Massey-Harris had not succeeded in incorporating into its line of tractors the three-point hitch and the Ferguson system, although Ferguson had been producing tractors with this feature since 1939 and a number of other firms had adapted it for their use. Relatively small R&D units are sometimes more productive than large ones. Thus the medium-sized firm may not face any handicap on this score compared with the large firm. The firm that is too small to have an R&D unit at all may face the most serious disadvantage. Sometimes new firms are established by individuals who have gained experience in larger firms. This was true of Versatile. But the position of the small firm would be stronger if there was a research program of some size in the universities and at government research stations. Not only would the research program provide a flow of ideas that would be accessible to small firms as well as large, but there would be a larger stock of trained personnel available for the small firms to draw on as consultants or to hire when experienced personnel in this category were needed. In addition, as has often happened in other industries, some of the personnel involved in the research programs might establish their own firms to exploit new developments.

As mentioned earlier, there has been a trend in recent years for the major firms not only to offer a large number of options on their basic machines, but also to offer machines in a larger number of different sizes. Production of a large range of options and sizes at a reasonable cost would be much easier for the larger firm. To avoid prohibitive costs, the small firm may have to concentrate on a few options and sizes that are in greatest demand. If the small firm sells in a single homogeneous agricultural area, the option problem would be easier since the range of options demanded would be limited. The size problem may create more difficulty. The demand for machines of different sizes reflects the great variety in the size of farms. The rapid increase in the average size of farms in recent years may have accentuated this problem. As the following data for Canada indicate, the distribution of commercial farms by different size categories was more dispersed in 1966 than it was 15 years earlier.

However, the fact that the structure of farm sizes is changing rapidly creates an opportunity for the new entrant who concentrates on supplying the range of farm sizes that is growing most rapidly. In recent years this has been the larger farms. A further advantage in concentrating on this sector of the market is the comparative lack of competition for second-hand equipment since the latter is typically of a smaller size. The cost side of the option and size-range problem will be examined in the next chapter.

The rapid growth in the average size of farm has been accompanied by a sharp reduction in the total number of farms and by an increase in the capitalization of the surviving units. All of this decline in numbers has been for small farms. The number of commercial farms increased from 235,000 in 1951 to 277,000 in 1966.

Size of Farms in Acres	Number of Commercial Farms	
	1951	1966
Under 3	465	1,056
3–9	2,092	2,937
10–69	13,287	15,448
70–239	95,639	90,343
240–399	44,093	51,014
400–559	26,886	33,740
560–759	21,167	28,220
760–1,119	17,454	28,140
1,120–1,599	8,286	14,656
1,600 and over	5,721	11,281

Source: Dominion Bureau of Statistics, *Ninth Census of Canada, Agriculture,* 1951, Vol. No. VI, Part I (Canada) (Ottawa: Queen's Printer, 1953), Table 41.
DBS, *1966 Census of Canada, Agriculture,* Cat. No. 96-601, Vol. III (Ottawa: Queen's Printer, February 1968), Table 30-1.

Average investment in machinery and equipment per commercial farm increased from \$8,500 to \$11,000 (in 1956 prices) over the same period. As these data make evident, the firm selling farm machinery must now sell to a smaller number of larger farms, typically operated by better educated, more sophisticated individuals. These changes have been accompanied by a large reduction in the amount of labour used by agriculture. In 1951 there was one person employed in Canadian agriculture for every 103 acres of improved land. By 1966 this ratio had fallen to one person for every 200 acres. With labour less available and more expensive, there has been a strong incentive to adopt labour-saving innovations in all phases of farming. This has created new opportunities for small firms. Grain augers, bale loaders, and front-end loaders, were all pioneered by small firms. The adoption of new farming methods has also created a demand for new types of equipment. The increased use of herbicides and pesticides has created a demand for sprayers, often supplied by smaller firms. Attachments for applying fertilizer and lime provide another example. On the other hand, many of the operators of the increasingly important larger farms are placing more emphasis on comfort, ease of operation and safety in their equipment. The larger firm may often be better able to meet these requirements.

The small firm who pioneers a new product may not be competing directly with the dominant firms in the industry and may have little effect on competitive conditions in the industry if he restricts his activities to these products. Still, firms who begin with a new product become potential entrants to other product lines. In 1953 Versatile's product line consisted mainly of sprayers, grain augers, and harrow drawbars. By 1968, its principal products were swathers, combines, and four-wheel-drive tractors.

Distribution Network

When a farmer buys a new machine he expects it to remain in use for 10 or 15 years or more, and he wants to be able to obtain replacement parts when needed over this period. For many machines such as tractors, seeders, and haying and harvesting equipment, he wants to obtain needed parts very quickly if the machine breaks down in a busy season. A new firm starting out in the farm machinery industry may find it difficult to provide the farmer with an assurance that the firm will be in business and able to supply the required parts over the lifetime of the machine. For this reason, new firms often produce machines that have fewer working parts, are less vulnerable to breakdown, and are used in farming operations where timing is less critical.

To provide the necessary sales and service for their machines, the major companies have established systems of franchised dealers backed up by a branch-house system, described in Chapter 11. The companies support their dealers by "floor planning" their stock of whole goods, by special credit terms on parts supply, through special training courses for dealer personnel, and in other ways. The dealers of the major firms are usually free to handle products of short-line firms that do not compete directly with the major firm's line of machines, but they are strongly discouraged from handling competitive machines. Thus, perhaps the major difficulty faced by a new firm attempting to establish itself as a long-line or full-line firm, or even in producing a few machines competitive with those handled by the major firms, is to get dealers who will handle its products. There are always a few dealers who handle more than one brand. But these are sometimes the less able and aggressive ones. And until the new entrant is able to offer a substantial range of machines, it may not be able to support its own independent group of dealers. To establish, finance and support the dealership system needed to provide the firm with a significant volume of sales is a difficult task. To overcome this obstacle successfully, the firm will need either a significant cost advantage that will make it possible to offer attractive terms to dealers, or some other equivalent attraction. Failing this, it will need substantial financial backing during the period of sales build-up.

In summary, it can be concluded that demand conditions in the farm machinery market make the entry of new firms difficult. This is particularly true for small firms. Entry is somewhat easier where a firm is owned by a large corporation that operates in related fields, such as automobiles or other industrial products. Entry into the North American market may also be easier for farm machinery firms that are already well established in Western Europe.

The demand conditions that make entry difficult are several. Demand for farm machines is highly seasonal and fluctuates erratically from year to year. Further, the longer-term growth in the total demand for farm machinery in North America has been only moderate, and in terms of the number of units demand has been falling as farms have become larger and fewer in number. In addition,

technological change in the industry has been fairly rapid. All of these considerations have probably favoured the larger established companies. Further, the importance of providing reliable repair parts and service facilities and the cost of financing marketing inventories also creates a significant barrier to entry. Small firms may have difficulty providing farmers with the assurance of a good repair parts service and in financing inventory at the dealer level.

Nevertheless, demand conditions are not uniformly unfavourable to entry. Rapid technical changes may create opportunities that small firms can successfully exploit and provide a basis on which they can successfully establish themselves. However, it will still be difficult for them to expand to a full line of machinery.

Chapter 7

ECONOMIES OF SCALE IN MANUFACTURING, AND OTHER COST CONDITIONS RELATED TO THE ENTRY OF NEW FIRMS

Economies of scale in manufacturing refer to the savings in production costs that arise at larger output volumes. If these economies are important, firms with larger volume should be able to undersell firms with smaller volume and the latter should disappear. If firms with small volume survive even though significant economies of scale in manufacturing exist, it suggests monopoly pricing on the part of the larger firms. The result is inefficiency in the sense that industry costs of production are higher than they need be. This chapter first examines economies of scale in tractor manufacturing. It then considers similar economies for combines and other kinds of farm machinery. The costs of a large number of options and a multiplicity of sizes are also examined.

Economies of Scale in Tractor Manufacturing

Estimates of economies of scale in tractor manufacturing are based on an engineering study carried out for the Commission by the management engineering firm of Booz, Allen & Hamilton Canada Ltd., which has had extensive experience in the planning of new plants in the metal fabrication field. Members of the Commission's staff worked closely with the firm in carrying out this study.[1] The results are believed to be reliable, and provide the only substantial body of firm data in this field. The study examines economies only at the manufacturing level. It does not consider possible economies in selling, distribution, finance, or research and development.

Estimates were prepared of the cost of manufacturing wheeled tractors for plants with annual outputs of 20,000, 60,000, and 90,000 tractors a year. This covers the range of output of all plants currently producing wheeled tractors in North America. Total tractor output in 1968 in North America was only 275,000.

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[1] N.B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969). An independent evaluation of this study is contained in D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Ch. 4.

The largest plants in North America produce no more than 50,000 to 60,000 annually, and a number have annual outputs of less than 20,000.

Each plant, as defined in the engineering study, was assumed to produce three different sizes of tractors, as follows:

Model	Horsepower Range Covered	Percentage of Plant Volume
About 40 HP	Less than 50	30
About 90 HP	51 to 99	60
About 130 HP	100 and over	10

This approximates the size pattern of current tractor sales in North America. A limited range of fairly standard options was included, and provision was made for sufficient factory space to manufacture a complete range of sizes and options.

To carry out this study the Commission, with the generous co-operation of the companies involved, supplied Booz, Allen & Hamilton with three tractors of the required sizes from each of six major tractor manufacturers. The firm then selected one line of tractors as representative of current tractor design, and completely dismantled each machine. A tractor contains just under 2,000 different parts. Some 1,365 parts, making up about 41 per cent of the component cost of a tractor, were evaluated as parts that a plant would normally *buy* at any of the above output volumes – parts such as tires, batteries, and generators (which reflect an entirely different manufacturing technology) or standard items such as nuts, bolts, and washers. From the remaining 600-odd parts, a selection was made of parts constituting just under 70 per cent of the total cost of components that would normally be manufactured in the tractor plant at an output level of 60,000. Engineers then prepared detailed specifications of how these parts should be manufactured, and estimated their manufacturing costs at the three output volumes. From these cost estimates the cost of the remaining 30 per cent of the components were then projected for each level of output. Cost of assembly and administrative and support costs were analyzed in detail.

The tractor factory was planned to incorporate the latest proven technology. A two-shift, five-day week was specified. Wage payments were made on the measured day work system. Cost estimates were prepared for each of the three basic stages of manufacture – the foundry, the machine shop, and the stamping plant. Buildings were depreciated at 5 per cent, machinery at 10 per cent, and special equipment at 33 per cent. The cost estimates do not provide specifically for profit but include a 7.5 per cent return to capital investment. The capital cost was taken at the 80 per cent level, to represent a plant that had been in operation for two years. To accommodate the fluctuations in output that are characteristic of the industry, the plants were designed to produce an output 20 per cent above the designated levels. Costs were estimated also for outputs 20 per cent above and below the specified annual volume.

Cost estimates for individual parts were based on planning sheets for each part at each stage of manufacture. A typical planning sheet would describe the operation; specify the crew size, the time required for each operation, and the set-up time; and describe the equipment, stating the cost of each piece of equipment. Manning tables, material requirements, capital requirements, and cost estimates were prepared for each of the three basic stages of manufacture. In addition, a complete plan for the factory was prepared including the number of administrative and support staff required, and the facilities needed for materials handling, storage, and other overhead functions. For the most part, costs were estimated on the basis of those prevailing in 1967-68 in the Chicago-Moline area. However, salary and wage rates and fringe benefits were taken at Brantford levels. Building and machinery costs, and salary and wage rates, were priced at the same level for all plant sizes. The cost of materials and purchased parts reflects the economies that accrue to a larger-volume purchasing operation.

In carrying out the analysis, a basic decision required at each level of output was whether to make or buy a given part. This required an estimate of the cost of manufacturing the component, and the price at which it could be purchased in the required volume. In arriving at this decision, an exception was made for the normal provision of a 7.5 per cent return on capital. Where new production facilities were required to manufacture a component, a pre-tax return of 20 per cent was considered necessary to justify such an installation. But once the basic decision had been made to have a foundry, a machine shop, or a stamping plant, any excess capacity would be utilized as long as it yielded a small return over actual costs. While the decision to make or buy basically reflects a cost comparison, the final decision reflects a number of non-economic considerations. Quality, reliability, flexibility and availability of supply, use of research and development facilities, and control of patents, favour in-house manufacture. Alternative sources of supply, and vendor goodwill and reciprocity, favour outside purchase. Other considerations favouring fabrication were bulkiness and difficulty of shipping, and risk of damage during transport.

Of the 600 parts referred to above on which make or buy decisions had to be made at the three volume levels, 259 were bought at the 20,000 level, 177 were bought at the 60,000 level and only 40 were bought at the 90,000 level. In the following analysis, the combination of parts made and bought at the 60,000 volume level will be referred to as the constant make-buy mix. The differing combinations made and bought at the three different volume levels will be referred to as the actual make-buy mix.

Estimated Cost Savings – The estimates prepared in the *Farm Tractor Production Costs* study show that economies of scale in tractor manufacturing are substantial. The cost reductions achieved by larger volume are shown in Table 7.1 on three different bases. The first estimate includes the saving obtained by manufacturing a larger number of components and by buying materials and parts in larger volume. It shows that a tractor plant with an annual output of 90,000 could

manufacture a tractor for 81 per cent of the cost of a 20,000-tractor plant. The difference in cost is $754 per tractor. At an output level of 60,000, unit costs are 88 per cent of costs in the 20,000-tractor plant, a difference of $463. Even if we assume a constant make-buy mix (the same components, of the 60,000 plant, manufactured in all three plants), the saving is $549 per tractor in the 90,000-unit plant as compared with a 20,000-tractor plant. A third approach considers only manufacturing costs in the sense of value added within the plant. This assumes a constant make-buy mix in all three plants and excludes savings that arise when parts and materials are bought in larger volume. On this basis manufacturing costs per tractor at 90,000 units are 74 per cent of those at 20,000. Costs per unit at 60,000 are 81 per cent of those at 20,000.

TABLE 7.1 – ESTIMATED ECONOMIES OF SCALE IN TRACTOR MANUFACTURING, NORTH AMERICA, 1967-68

	Annual Output of Tractors		
	20,000	60,000	90,000
Actual make-buy mix			
Total cost per tractor	$3,875	$3,412	$3,121
Index[1]	100	88	81
Constant make-buy mix			
Total cost per tractor	$3,824	$3,412	$3,275
Index[1]	100	89	86
Constant make-buy mix, excluding materials and purchased components[2]			
Cost, in sense of value added	$1,303	$1,052	$ 968
Index[1]	100	81	74

[1] Costs at 20,000-unit volume equal 100.
[2] Estimated as the sum of labour, support, facilities, and capital costs.
Source: N.B. MacDonald, W.F. Barnicke, F. W. Judge, and K.E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale,* Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969).

It is useful to evaluate these cost savings in terms of their implications for the return on investment that can be earned at different levels of output. Rates of return for the actual make-buy mix are shown in Table 7.2. These estimates assume a realistic price per tractor at the factory door of $4,000. On this basis, with the actual make-buy mix, a price per tractor that would yield a return of 11.8 per cent to the 20,000-unit tractor plant would earn 32.7 per cent for the 60,000 plant and 44.8 per cent for the 90,000 plant. All rates are before corporate income tax. For plants with a constant make-buy mix the corresponding rates of return are 13.3 per cent, 32.7 per cent, and 41.6 per cent.

The tractor price assumed and the absolute level of these rates of return are to some degree arbitrary. The significant fact is the large increase in the rate of return that results from a larger scale of output. Moreover, the study indicated that economies of scale are not exhausted by a 90,000-unit tractor plant. Explicit

estimates for larger volumes were made only for the stamping plant, where costs were shown to continue to decline at least up to a 200,000-unit volume. Further, while these cost estimates include tooling costs they do not include the cost of designing, building prototypes, and testing a new line of tractors. In its submission to the Commission, Massey-Ferguson estimated its cost of developing a new line of tractors with appropriate engines at $17.5 million. Allocated over a 10-year period, this would amount to $87.50 per tractor for a 20,000-tractor plant, $29.17 at 60,000 units, and $19.45 at 90,000 units. Thus design and development costs would add significantly to the cost differences given in Table 7.2.

TABLE 7.2 – ESTIMATES OF RATES OF RETURN ON INVESTMENT IN TRACTOR PLANTS, BY PRODUCTION VOLUME AND MAKE-BUY MIX

	Annual Output of Tractors					
	Constant Make-Buy Mix			Actual Make-Buy Mix		
	20,000	60,000	90,000	20,000	60,000	90,000
	(Dollars)					
(1) Price of tractor	4,000	4,000	4,000	4,000	4,000	4,000
(2) Unit cost, including 7.5% return on investment	3,824	3,412	3,275	3,875	3,412	3,121
(3) Unit profit	176	588	725	125	588	879
(4) Total profit ('000)	3,520	35,280	65,610	2,500	35,280	79,110
(5) Total cost of building, land, equipment, tooling, inventory ('000)	60,299	140,062	192,629	58,025	140,062	211,851
	(Per cent)					
(6) Rate of return on investment, incl. 7.5% noted in (2)	13.3	32.7	41.6	11.8	32.7	44.8

Source: N.B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), Tables 40, 44 and 47.

Sources of Economies of Scale – Economies that result from a larger scale of plant can be analyzed in two different ways – in terms of the type of cost involved and in terms of the stage of manufacture.

A breakdown of the cost of tractor manufacture into such components as materials, labour, operating expenses, support, facilities, and capital cost is provided in Table 7.3. This table also shows the extent to which each of these costs declines, per tractor, for the constant make-buy mix, as the size of tractor plant increases.

TABLE 7.3 – ESTIMATED UNIT COSTS OF FARM TRACTORS BY TYPE OF COST AND VOLUME OF OUTPUT

	Annual Output of Tractors					
	20,000	60,000	90,000	20,000	60,000	90,000
Constant make-buy mix		(Dollars)			(Costs at 20,000-unit volume = 100)	
Material						
Parts (not subject to make-buy decision)	1,519	1,420	1,377	100	93	91
Parts (subject to make-buy decision)	437	408	396	100	93	91
Foundry, stamping plant, and machine shop materials	412	397	391	100	96	95
Material costs	*2,368*	*2,225*	*2,164*	*100*	*94*	*91*
Labour costs	432	385	364	100	89	84
Operating expenses	153	135	133	100	88	87
Support costs	279	231	215	100	83	77
Facilities costs	413	293	268	100	71	65
Capital costs	179	143	131	100	80	73
Conversion costs	*1,456*	*1,187*	*1,111*	*100*	*82*	*76*
Total unit costs, constant make-buy mix	3,824	3,412	3,275	100	89	86
Total unit costs, actual make-buy mix	3,875	3,412	3,121	100	88	81

Note: Estimates of components of total unit costs based on constant make-buy mix. Differences in material costs reflect purchase price differences. "Labour" includes wages and salaries of all workers including maintenance, clerical, and supervisory workers charged to foundry, stamping plant, machine shop, and assembly plant. Operating expenses include utilities, factory and clerical supplies, hand tools, heat, and sundries. Support costs include wages and salaries and other expenses of administration not charged to individual shops. Facilities costs include depreciation of plant and equipment. Capital costs include interest charges on funds invested in plant, equipment, and inventories.

Source: N.B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale,* Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), Table A49-1.

As the data in Table 7.4 show, the saving in total cost per tractor obtained by increasing the size of plant from 20,000 to 90,000 can be almost equally divided among savings on materials, on capital and facilities costs and on all other costs (all with the make-buy mix held constant) and the increased fabrication of components, instead of their purchase, made possible by the higher production volume. However, the significance of these different costs changes as volume increases. The saving on materials, and on capital and facilities costs, accounting for 31 and 34 per cent of the total saving, are the most significant factors, as output increases from 20,000 to 60,000. Beyond 60,000 units, the saving from increased in-house fabrication is the most significant factor, accounting for 53 per cent of the total. Let us examine each of these cost savings.

TABLE 7.4–REDUCTION IN UNIT TRACTOR COSTS AS VOLUME INCREASES

	Increase in Annual Output of Tractors					
	20,000 to 60,000		60,000 to 90,000		20,000 to 90,000	
	$	%	$	%	$	%
Reduction in cost (with make-buy mix held constant)						
Material	143	31	61	21	204	27
Capital and facilities	156	34	37	13	193	26
All other	113	24	39	13	152	20
Sub-total	412	89	137	47	549	73
(with make-buy mix changed to reflect opportunities related to higher volume)						
Increased fabrication of components	51	11	154	53	205	27
Total	463	100	291	100	754	100

Source: N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale,* Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), based on Table A49-1.

The saving on materials in a larger plant reflects the economies of packaging and shipping in larger volume, together with the saving that results when more specialized buyers can be employed. It was estimated that on purchased parts, when compared with a 60,000-unit operation, costs would be 7 per cent higher at 20,000 units and 3 per cent lower at 90,000 units. No comparable savings were assumed on the purchase of standard materials such as steel or pig iron.

The savings that result when a plant manufactures a larger proportion of a tractor's components reflect a variety of factors. To some degree it reflects a saving in transport and shipping costs. But, since inbound transport costs in this industry are small–less than 1.5 per cent of shipments–this must be a minor factor. It also reflects the avoidance of the monopoly profits that specialist suppliers can earn on components. However, the most important source of saving is the more complete utilization of capital and support facilities. This is evident from the following comparison of costs for two plants of the 90,000-unit size, one with a make-buy mix suited to the 60,000-unit level, and the other with a make-buy mix that allows a much larger number of components to be manufactured within the plant. As these data show, it costs only $201 to manufacture parts whose purchase price is $355. The major saving is on support, facilities, and capital costs. No additional cost for support and administrative staff was considered necessary to produce the additional parts, and the additional costs for capital and facilities were comparatively small. This undoubtedly reflects the fact that certain facilities that are

needed in a constant-mix, 90,000-tractor plant will be more completely utilized when a larger number of components is manufactured.

	Unit Costs of 90,000-Tractor Plant[2]		
	Constant Make-Buy Mix	Actual Make-Buy Mix	Difference
		(Dollars)	
Costs of:			
Parts (not subject to make-buy decision)	1,377	1,377	–
Parts (subject to make-buy decision)	396	41	−355
Materials	391	482	91
Labour	364	416	52
Operating expenses	133	147	14
Support	215	215	0
Facilities	268	297	29
Capital	131	146	15
Total in plant	1,502	1,703	201
Total cost per tractor	3,275	3,121	−154

Even when a constant make-buy mix is assumed, the saving on facilities and capital is very substantial. Unit costs for facilities and capital combined are almost one-third lower for a 90,000-tractor plant than they are in a plant that produces only 20,000 tractors a year. The saving on facilities, which comprises depreciation on plant and equipment, the write-off of tooling, and a few related costs such as insurance and property taxes, amounts to 35 per cent. It is particularly large for tooling, with unit costs for a 90,000 plant being only one-third of those for a 20,000 plant. However, tooling accounts for only a small part of total facilities costs. The corresponding saving on capital costs, which comprise the 7.5 per cent return on investment, is 27 per cent (see Table 7.3).

In this analysis labour costs include the wages and salaries of all workers at the factory level including maintenance, clerical, and supervisory workers. The savings here are less substantial. Unit costs fall only 16 per cent as the size of plant increases from 20,000 to 90,000. Savings in the use of set-up labour are quite substantial. But set-up labour is only a small part of the total. The saving in operating expenses is also comparatively small, with unit costs falling 13 per cent as the plant size increases from 20,000 to 90,000.

Savings in support costs are more substantial. Unit costs here fall 23 per cent over the range of plant sizes considered. Support costs include the wages and salaries and other expenses of administration that are not charged to individual shops in the factory. They include these costs for materials handling and storage.

[2] MacDonald, Barnicke, Judge, and Hansen, *op. cit.*, Table A49-1.

Analysis of Economies by Process and Function – Table 7.5 shows how costs per tractor vary for the three different plant sizes in the foundry, the stamping plant, the machine shop, and the assembly operation. It also shows the variation in the cost of purchased parts and in administrative and support costs. The data are for a plant in which the same parts are made or bought at all volume levels.

Economies of scale are substantial in all these areas. They are largest for stamping. Stamping costs per unit in a 90,000-tractor plant are only 72 per cent of those for a 20,000-unit plant. However, because stampings make up only a small part of a tractor, the total saving on stampings between 20,000 and 90,000 is only $49 per unit, about 9 per cent of the total saving. The savings on administrative and support costs, and on foundry, machine shop, and assembly costs, are all similar in size, unit costs at 90,000 volume being, respectively, 79, 81, 82, and 84 per cent of those at 20,000.

Although the saving in the cost of purchased parts is only 9 per cent as the size of plant increases from 20,000 to 90,000 units, this item makes up such a large part of the tractor's total cost that this saving accounts for one-third of the total cost reduction. An additional 20 per cent of the total cost saving occurs in the foundry and 19 per cent in the machine shop. The assembly operation contributes least to the total cost reduction, providing a saving of just $31 per tractor, about 6 per cent of the total.

TABLE 7.5–TOTAL UNIT COSTS OF FARM TRACTORS BY VOLUME OF OUTPUT AND BY MANUFACTURING PROCESS AND FUNCTION

(Constant make-buy mix)

	Annual Output of Tractors					
	20,000	60,000	90,000	20,000	60,000	90,000
	(Dollars)			(Index: Costs at 20,000-unit volume = 100)		
Costs of:						
Purchased parts	1,956	1,828	1,773	100	93	91
Foundry	581	490	469	100	84	81
Stamping	177	138	128	100	78	72
Machining	581	502	478	100	86	82
Assembly	193	171	162	100	89	84
Administrative and support	336	283	265	100	84	79
Total costs	3,824	3,412	3,275	100	89	86

Source: Data in dollars from N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), Table 40.

Evaluation – This analysis has shown that the manufacturing cost of a tractor for a plant with a 90,000-unit output is almost 20 per cent less than for a plant producing only 20,000 tractors a year. At the 90,000 level, a plant uses about 26

per cent fewer resources than at 20,000. Since North American production of wheeled tractors is currently only about 250,000 units annually, and production in the non-Communist world is only around 800,000 units, it is clear that there is room in the industry for only a small number of firms with output of 90,000 tractors or more. The significant decline in costs and the increase in profitability as the size of annual output increases clearly demonstrates that economies of scale are a very significant barrier for the entry of new firms to the industry. The implications of this for the pattern of competition in the industry are assessed in Chapter 9.

Economies of Scale in Combine Manufacturing

No independent estimate of the size of economies of scale for combines and other farm machines is available. However, some conclusions will be attempted on the basis of the data provided in *Farm Tractor Production Costs.* Combines will be considered first and then other farm machines.

Combines are large complex machines containing many components such as engines, transmissions, and hydraulics, which are similar to those found on tractors. However, a combine involves much more stamping and less machining and foundry work. The difference is shown in Table 7.6. Stampings account for some 39 per cent of the value added by manufacturing in combine production, compared with only about 8 per cent in tractor manufacture. Since economies of scale are more important in stamping than in casting, machining, or assembly, this would suggest that economies of scale for combines are even larger than for tractors. On the other hand, combine production also involves a significant amount of welding, and economies of scale are believed to be less important here.

TABLE 7.6–PERCENTAGE OF VALUE ADDED, BY PLANT PROCESS, TRACTORS AND COMBINES, NORTH AMERICA, 1968

Plant Process	Tractors	Combines
Foundry castings	33	18
Machining	40	22
Stamping	8	39
Assembling	19	21
Total	100	100

Source: Tractors derived from data in N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K.F. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale,* Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969); Combines from Commission estimates.

The *Farm Tractor Production Costs* study provided some additional data on the cost of combine stampings. The decline in the cost of a set of stampings as volume increases varies with the ratio of conversion cost to the cost of materials.[3] Using these data provides the following estimate of stamping cost on the basis of

[3] Conversion costs are the cost of converting the raw material into finished stampings.

cost at an output of 20,000 units equalling 100, and assuming a ratio of conversion cost to materials at that volume level of 180 to 100.

	Index of Stamping Cost	
Annual Output of Combines	Conversion Costs	Total Cost
500	214	182
2,500	184	160
5,000	159	142
10,000	134	123
20,000	100	100

These data suggest that a set of combine stampings for a 5,000-unit plant would cost 42 per cent more than for a plant with an annual output of 20,000. For a plant with an output of only 500 combines and no other production the cost would be about 28 per cent higher than at 5,000.

Using this set of stamping costs and combining them with the cost of foundry, machining, assembly and support costs, as shown in the tractor study, it is possible to obtain the rather rough estimates of economies of scale for combines shown in Table 7.7.

TABLE 7.7 – INDEX OF ECONOMIES OF SCALE IN COMBINE MANUFACTURING COSTS, CANADA, BY VOLUME OF OUTPUT

(Costs at 20,000-unit volume = 100)

	Annual Output of Combines				
	500				
	Single Purpose	Multi Purpose	5,000	10,000	20,000
Costs of:					
Machining	110.3	107.7	106.6	103.7	100
Stamping	182.2	155.8	141.6	123.3	100
Assembly	133.9	122.6	114.5	104.5	100
Finished parts	111.7	110.1	108.9	105.3	100
Total costs	128.4	120.2	115.4	108.0	100

Source: Estimates by Commission staff. Further details are provided in a note to this chapter.

These estimates indicate that manufacturing costs for a combine at the 5,000-unit level would be about 15 per cent higher than at the 20,000 level, adding about $750 to the cost of a medium-sized self-propelled combine. At an annual output of 500, total manufacturing costs would increase a further 4 per cent, or by $235, on the assumption that at this low volume the combine would be produced along with other farm machines in a multi-purpose plant. A plant producing combines only, at a volume of 500 a year, would have still higher costs. These

estimates assume the same mix of components manufactured in the plant at each volume level. The tractor cost study indicates that a larger number of components would be fabricated at the higher volumes of output, and that this would yield additional cost savings. On the other hand, except for the special estimate for a multi-purpose plant at the 500 level, the estimates assume that the combine plant is being operated by an independent company with no related manufacturing activity. In fact, most combine manufacturers also produce other farm equipment and may thus gain some economies not reflected in the above estimates. These two considerations would partially offset one another.

Some additional points about these estimates should be noted. First, the estimates assume that fully assembled engines are purchased. Several of the major combine producers manufacture their own engines in separate plants. Second, it was assumed that none of the plant sizes considered would justify a foundry operation. Castings are included in purchased parts and any reduction in the cost of castings with larger output are those that accrue to a larger volume purchasing operation. In fact, a number of the firms have foundries that supply castings for combines, tractors, and other farm machines. Third, economies of scale in administration and support activities were not estimated separately; they were included as part of the various processes listed.

The above estimates cover the range of output of most combine manufacturers outside of the Soviet Union. Total output in 1965 in North America was estimated at 53,000, of which Deere produced 13,500, International Harvester 10,000, Massey-Ferguson 9,600, Allis-Chalmers 8,500, Case 4,800 and Cockshutt 4,000. The only combine operations on this continent with very small volume were those of Versatile which produced 500 in a multi-purpose plant in Winnipeg, International Harvester which produced about 500 in a multi-purpose plant in Hamilton, and New Holland which manufactured about 1,000 in Nebraska. The latter operation is largely assembly, with many of the major components of the combine being manufactured in the large Clayson plant in Belgium. In Western Europe, the largest single producer is Claas whose output in 1965 has been estimated at 22,000. In the Soviet Union, the world's largest combine plant at Rostov produces an estimated 80,000 combines a year.

As the estimates in Table 7.7 indicate, economies of scale in the manufacture of combines are realized at least up to an annual output of 20,000 units per year and there may well be significant economies beyond that point. Conversion costs for combine stampings, which make up over two-thirds of total stamping costs for a plant with an output of 10,000 combines, decline by 25 per cent as output increases from 10,000 to 20,000 units. Thus a further significant decline in stamping costs beyond 20,000 units could be expected. It is evident from these data that economies of scale provide a significant barrier to entry for smaller firms desiring to enter the combine manufacturing field. The significance of this for the pattern of competition is discussed in Chapter 9.

As noted earlier, the estimates of economies of scale for tractors and combines described above were based on an assumption that each product was produced separately by a firm having no other related manufacturing operations (except for the estimate for the multi-purpose plant for combines at the 500-unit level). In fact, most of the farm machinery companies produce a variety of farm machines and often other related products. Thus some of the companies who have small volume on individual products may gain some economies by producing components for tractors, combines, and other products in the same plant. For example, a single plant may produce transmissions for both tractors and combines. A foundry may produce castings for tractors, combines, and a number of other farm machines. The same may be true of stamped and machined products. Some allowance must be made for these considerations in interpreting the significance of the estimates of economies of scale outlined above.

Using these estimates of manufacturing economies of scale for tractors and combines, it is possible to estimate roughly the additional cost involved in the smaller-scale manufacturing operations that actually exist in this industry. In a study prepared for the Commission, David Schwartzman has estimated that these added costs amount to from 7 to 8 per cent for tractors and to 8 per cent or more for combines.[4] Both estimates apply to production in North America and make some allowance for the considerations outlined in the preceding paragraph.

Economies of Scale for Other Farm Machines

No attempt has been made to estimate in any quantitative fashion the economies of scale involved in the manufacture of other farm machines. However, it is clear that most of these machines are less complex and sophisticated than either tractors or combines, and it is reasonable to assume that economies of scale will be less significant. For many machines, such as cultivators and harrows, relatively little stamping, machining, or casting is required. Much of the work consists of simpler manufacturing operations such as cutting, drilling holes, painting, and assembly. Because the overhead capital required for these operations is smaller, the economies of scale that accompany them are smaller as well. Further, it was shown for tractors that a significant part of the economies of scale resulted from purchasing parts and components in larger volume. For simpler machines, most of the purchased inputs are bulk materials that do not yield the economies that result from specialized buying.

Evidence to be presented later on the extent to which manufacturing of various machines is concentrated in the hands of a small number of firms also supports the conclusion that economies of scale are less significant for these other farm machines than they are for tractors and combines. In this part of the industry, concentration ratios are generally lower, and in many cases they have declined over

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[4] D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970).

the past decade. The lowest concentration ratio in Canada is for weeding, cultivating, and tilling machines. However, this picture is not uniform: the share of the haying machinery market held by the four largest firms is slightly higher than for tractors and about the same as for combines.

Non-Plant Economies of Scale

Economies of scale may well exist in a number of areas outside manufacturing. However, little is known about their size and there is no easy way to estimate them. Nevertheless, some brief consideration will be given to a number of these activities. Most of the full-line and long-line firms in the industry are large multi-plant firms. Each of them should realize many, if not all, of the economies that are available beyond the plant level.

Elsewhere in this Report it is estimated that for a major farm machinery company, general and administrative expenses amount to about 3 per cent of net sales, branch-warehouse operating expenses to about 7 per cent, inventory financing to about 5 per cent, and research and development costs to about 3 per cent. Thus, in total, some 18 per cent of net sales are for activities beyond the plant manufacturing level. Consider each of these in turn.

General and Administrative Expenses – The study *Farm Tractor Production Costs* estimated economies of scale in central-office general and administrative costs, for a plant with a variable make-buy mix of tractors as follows:

Annual Output of Tractors	Administrative and Support Costs per Tractor	Index of Cost per Tractor
	(Dollars)	
20,000	336	100
60,000	283	84
90,000	265	79

A firm with an annual tractor output of 20,000 would have annual sales at the factory of about \$80 million. This would increase to \$240 million at 60,000 and \$360 million at 90,000. Thus these data suggest that administrative and support costs would fall about 16 per cent as sales (at 1967 prices) increased from \$80 to \$240 million and would fall a further 6 per cent when sales increased to \$360 million. If a small firm is considered to be one with annual sales of \$80 million or less, compared with a large firm of over \$360 million, then it can be estimated that general and administrative expenses would be about 4 per cent rather than 3 per cent of sales.

Distribution – Wholesale distribution costs of large firms are about 7 per cent of sales. As will be demonstrated later, there are some economies of distribution, mainly relating to the average size of dealer. In Canada, branch-house distribution

costs of the major companies fell from 9.6 per cent of sales in 1961 to 7.0 per cent in 1966. During the same period industry sales increased from $202 million to $417 million. Some of this decline in distribution costs undoubtedly reflected economies that accrue to a larger-scale operation. However, other factors would be involved as well. It cannot be assumed that the company's distribution organization would have been operating exactly at planned capacity in either 1961 or 1966. It may have been operating below capacity in the early year and above normal capacity in the later year. In addition, there is evidence that some of the economies of scale that accrue as average sales per dealer increase could be obtained by the smaller companies simply by reorganizing their dealership system. A reasonable estimate for branch-house distribution costs for smaller firms would be about 9 per cent. This is still substantially below the margin that would be charged by an independent distributor, which has been estimated at 16 per cent. However, it is not an estimate in which one can have great confidence, because wholesale distribution costs appear to vary substantially from company to company, irrespective of size, and apparently involve a large element of management discretion.

Interest-Free "Floor-Planning" – The cost of interest-free "floor-planning" of inventory in the hands of the dealer has been estimated, in the case of the larger companies, at about 5 per cent of net sales. There is also evidence that large dealers have an inventory turnover that is at least 50 per cent larger than for small dealers. On this basis it could be estimated that the cost of floor-planning for a small company might be around 7 per cent of sales. However, there is some doubt as to whether all of this represents a genuine cost to the industry that should be included as part of non-plant costs (see discussion in Chapter 11).

Research and Development – Research and development expenditures undoubtedly also yield significant economies of scale. Deere's R&D expenditures are currently about 4 per cent of sales. Such a ratio would yield a very much larger research expenditure for the major firms than it does for small firms. On the other hand, there is at least some evidence that relatively small research laboratories have often produced more new ideas than very large research establishments. In addition, the individual with unusual inventive ability may earn a much larger income if he can successfully establish his own firm than he would ever make on a salaried basis in a large firm. Still, there must be some advantage accruing to the large firm. It will be assumed that an expenditure of 3 per cent of net sales for a large firm will yield the same return as 5 per cent for a small firm.

Consideration of all these factors outside the actual manufacturing process suggests that non-plant economies of scale amount to about 25 per cent of net sales for a small firm and 18 per cent for large firms. This suggests a rather larger decline than is true for costs at the plant level. However, since these estimates are subject to a considerable margin of error, and since non-plant costs are only about one-fourth or less of the total, it is assumed that the behaviour of total costs per unit as volume increases does not differ significantly from costs at the manufac-

turing level. In brief, it is assumed that total costs per unit for a large firm, with annual sales of $450 million or over, are only about 80 per cent of those of a small firm, one with annual sales of $100 million or less.

Conclusion on Scale Economies

It is clear that economies of scale of plant and firm are formidable barriers to the entry of new firms in this industry. This is particularly true for major products such as tractors and combines. It undoubtedly applies in some measure also to a number of other products such as hay-balers and swathers. If the existing level of output were concentrated in a smaller number of plants, there would be significant cost savings. For North America the saving has been estimated at from 7 to 8 per cent for tractors and at 8 per cent or more for combines.

Costs of Additional Sizes, Options, and Models

In recent years the farm machinery industry has greatly increased the number of sizes, options, and models it offers on most of its major machines. While it is not easy to quantify the addition to cost involved in this added variety, some consideration will be given here to the factors involved.

The added cost of an option will depend on the volume in which it is sold, whether it is an "off the shelf" item or has to be specially manufactured, and whether it is a simple "add or omit" item or can only be included with additional labour and other costs. Apart from the cost of the option itself, the cost penalties associated with its inclusion consist of the cost of incorporating the added feature into the design of the machine, the cost of procuring and testing the parts or manufacturing them "in house", the added cost of storage and handling the additional parts, and the net cost of their assembly into the final product.

Some of the costs involved in any option are fixed, in the sense that they remain unchanged no matter how many units of the particular option are sold. In respect to these fixed costs, the cost of each option will depend on the volume sold. These fixed costs include the engineering and other work in specifying the part and making provision for its addition to the machine. If the part is to be manufactured, an order must go to the plant specifying how it is to be made, to what dimensions, and with what materials and finishes. If the part is bought and is not readily available as a standard item, similar instructions must be provided to the outside supplier. Instructions also have to be provided as to how and where it is to be included in the final machine.

Once the option has been specified, it has to be scheduled. This requires purchase orders to vendors, or manufacturing instructions to the firm's own plants, indicating the timing and volume of the option to be provided. As the number of possible options increases, the task of forecasting potential demand for each becomes more difficult, and manufacturers may find they have to carry some safety margin with an additional inventory cost to satisfy their customers. This is

particularly true of options that have to be produced to order, usually on a batch basis.

The volume of any option and the frequency with which it is included on a machine seriously affects its cost. Larger volume allows the cost of setting up and administering the option to be spread more widely. Frequency of inclusion reduces penalty costs associated with dealing with an unfamiliar item on the assembly line.

"Off the shelf" items, such as tires, are less expensive than items that are specially designed and manufactured. The same is true of standard items such as starters, generators, belts, pulleys, and bearings. Items manufactured in the firm's own plant will be less expensive if they are compatible in manufacturing technique with the rest of the machine. Additional gear ratios in a transmission will cost less if the transmission case is already large enough to handle them. "Add on" options may make it more difficult to schedule an assembly line and avoid idle time at some work stations. All options involve some penalty in the form of the cost of scheduling, additional inventory, and material handling.

One example of where a manufacturer provides an additional tractor model at a modest extra cost is the use of a turbo-charger to obtain higher horsepower from the existing engine. This involves a "hang on" option to a largely unchanged engine. But the transmission must be designed so it can transmit the extra power with the same service life. Some firms have attained this extra transmission capacity by micro-finishing all the gears so that the gear teeth mate together better for less wear and longer life. In this way, a larger horsepower tractor was obtained at modest additional cost. Thus, while it is clear that the trend towards additional variety in terms of sizes, options, and models has added to farm machinery costs, it is not possible to quantify these added costs in any simple way. In some instances, at least, the additional features have been provided at modest additional cost. Because the additional variety involved is cheaper for a larger-volume operation, this recent trend has undoubtedly provided some additional advantage to the larger firm. As such, it has added further to the entry barriers that exist in the industry.

Note to Chapter 7

ECONOMIES OF SCALE IN COMBINE MANUFACTURING

This note describes how economies of scale in combine manufacturing were estimated. The basic resources used were combine manufacturing costs supplied for 1966 by three companies, Massey-Ferguson (for the 410 model at its Brantford plant), Cockshutt (for its 542 model at Brantford) and Versatile (for its 420 model built in Winnipeg). Because of differences in manufacturing processes, degree of vertical integration, and input factor costs, the costs for the three companies could not be compared directly. Instead, costs for the Massey-Ferguson machine were analyzed using the additional detail supplied for the two other plants. Costs were estimated for annual outputs of 500, 5,000, 10,000, and 20,000 units. Costs are presented as relative numbers only.

Two limitations of the analysis should be noted. Except for the 500-volume level, costs are estimated for special-purpose plants, making no other products but combines. A constant make-buy mix is assumed at all volumes. The latter assumption means that cost reductions with increased volume will be significantly understated. The former assumption has an opposite effect. Many existing farm machinery manufacturers obtain economies by producing components for different products in a single plant, thus obtaining larger volume output and some associated cost savings. The net effect of these two partially offsetting considerations is indeterminate.

Procedure Used in Developing Cost Estimates

For every cost area of a combine (17 in all), data were available on the value of assembly plant end-items divided between "made" and "bought" items. The "made" items were divided among stampings, assemblies of stampings, and machined parts. Estimated costs for stamping and machined parts were then divided between raw materials and conversion costs (labour and overhead) using ratios developed in the tractor cost study. Assembly costs were provided separately for labour and overhead costs. The resulting cost breakdown shown in Table 7.8 was taken as approximating combine manufacturing costs at a 10,000-unit volume. Changes in costs with volume were then estimated for each of the various cost areas of a combine plant.

TABLE 7.8 – BREAKDOWN OF COMBINE MANUFACTURING COSTS AT 10,000-UNIT VOLUME

	Percentage of Total Costs
Materials and parts	
Castings	7.1
Forgings	1.7
Other machining materials	0.6
Stamping materials	6.3
Finished parts	38.0
Total materials and parts	53.7
Machining	13.8
Stamping	14.5
Assembly	18.0
Total costs	100.0

Source: Commission estimates.

While there are specialized plants producing only combines in the output range of 5,000 units or more, plants producing only 500 per year do so on a batch basis in a multi-product facility. For this reason costs at the 500-unit level were estimated both for a single-purpose and a multi-purpose plant. For the multi-purpose plant it was assumed that material costs would be close to those in a 5,000-unit plant, but labour would incur some penalty by being forced to change more frequently from one job to another. The same would apply to indirect labour. Building costs and the cost of machines should not diverge greatly from those achieved in a higher-volume, single-purpose plant. Inefficiencies will arise because more storage space is required, from "down time" while machines are changed over, and from idle time on special-purpose machines. Tooling used for combines only will be a unique penalty cost to the low-volume plant. Factory expense is unlikely to involve any significant penalty.

Analyzed in detail for each volume level were machining costs, stamping costs, finished parts costs, assembly costs, and total costs. It was assumed that the combine plant would not have its own foundry. While the Massey-Ferguson combine plant at Brantford draws castings from the M-Foundry, this is economically justifiable only because of the added volume provided for other production, including tractor production at Detroit. Hence, all castings for all plants were assumed to be purchased outside.

Machining Costs – The pattern to be used in subsequent tables is shown in Table 7.9. Materials costs and conversion costs are each shown relative to costs at the 20,000-unit volume. The same is true for total manufacturing cost.

TABLE 7.9–INDEX OF COMBINE MACHINING OPERATIONS COSTS

(Costs at 20,000-unit volume = 100)

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
Materials					
Castings	32.4	32.3	32.2	31.8	31.2
Forgings	7.9	7.8	7.8	7.7	7.5
Other materials	2.9	2.8	2.8	2.8	2.8
Total materials	43.2	42.9	42.8	42.3	41.5
Conversion					
Labour	17.3	16.1	15.6	15.2	14.8
Overheads	49.8	48.7	48.2	46.2	43.7
Total conversion	67.1	64.8	63.8	61.4	58.5
Total costs	110.3	107.7	106.9	103.7	100.0

Source: Commission estimates.

The cost of castings bought outside are shown as rising only moderately as volume declines, on the assumption that they are being supplied from a modern foundry with sufficient over-all volume to achieve available economies of scale. Assuming that the parts required by the lower-volume combine plants are compatible with other parts being made in the foundry (so that flask sizes, moulding lines, core machine sizes, etc., do not have to be changed over), the extra costs at lower volumes would be largely limited to the required patterns being written off over a lower volume for each part.

Forgings would probably be subject to greater economies of scale than castings because of higher set-up and tooling costs. Labour and overheads are shown as increasing only moderately up to the 500-volume multi-purpose plant, but rising steeply for the single-purpose plant at that volume. The cost of machining materials increases only slightly as volume decreases.

Stamping Costs – It was estimated that the unit cost of stamping materials would rise about 25 per cent between the 20,000-unit plant and the 500-unit single-purpose plant. The large plant could buy its steel in bulk in most cases directly from the mill - whereas the smaller plant, using only one-fortieth as much steel annually, would be forced to buy from steel warehouses in small lots. The multi-purpose 500-unit plant is shown as having only slightly higher material costs than a 5,000-unit plant. Some added costs arise from the purchase of small amounts of special sizes and specifications of steel.

TABLE 7.10 INDEX OF COMBINE STAMPING OPERATIONS COSTS

(Costs at 20,000-unit volume = 100)

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
Materials	44.8	40.9	39.7	37.4	35.9
Conversion					
Labour	44.8	38.1	33.6	32.5	30.8
Overheads	92.6	76.8	68.3	53.4	33.3
Total conversion	137.4	114.9	101.9	85.9	64.1
Total costs	182.2	155.8	141.6	123.3	100.0

Source: N.B. MacDonald, W.F. Bärnicke, F.W. Judge, and K.E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), Table 20.

Estimates for both the materials and conversion costs of combine stampings were provided in the tractor cost study.[5] Analysis of combine weights and the ratio of stamping costs to total costs indicated that for a 10,000-unit plant, conversion costs would amount to about 240 per cent of materials costs. Total stamping costs were estimated using this ratio. As Table 7.10 shows, stamping costs rise steeply with the 500-unit multi-purpose plant having costs more than 50 per cent higher than those of a 20,000-unit plant. Because stampings are such an important part of a combine, this steep rise in costs is a major contributor to economies of scale in combine production.

Finished Parts Costs – Because many of the bought-outside finished items are produced by specialist producers able to take advantage of long production runs, the cost penalties associated with lower-volume production are moderate in size. These costs are shown in Table 7.11.

[5] MacDonald, Barnicke, Judge, and Hansen, *op. cit.*, Table 20.

TABLE 7.11–INDEX OF ESTIMATED COSTS OF PURCHASED PARTS FOR COMBINES

(Costs at 20,000-unit volume = 100)

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
Purchased parts costs	111.7	110.1	108.9	105.3	100.0

Source: Commission estimates.

Assembly Costs – The costs of assembly are shown in Table 7.12. The assembly of a combine differs from that of a tractor in that a great deal of gas welding is required, particularly in the main frame or body. This process is not subject to much economy of scale, with additional volume being attained by more machines and more workers, rather than machines with increasing productivity. Some economies of scale are possible, however, by greater specialization in the welding of particular areas. Diseconomies will be evident if the welding equipment in the low-volume plant, single- or multi-purpose, is not utilized fully.

TABLE 7.12–INDEX OF ESTIMATED COSTS OF COMBINE ASSEMBLY OPERATIONS

(Costs at 20,000-unit volume = 100)

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
Labour	37.1	36.8	35.5	33.9	32.2
Overheads	96.8	85.8	79.0	70.6	67.8
Total costs	133.9	122.6	114.5	104.5	100.0

Source: Commission estimates.

It is in assembly operations that batching tends to be most evident. Even a plant of the size of the Massey-Ferguson plant at Brantford cycles the production of its combines between models, and produces specialty machines, such as rice combines, at intervals. Smaller companies produce fewer models. Versatile, for example, produces only one.

The ratio of labour to overhead costs at the 10,000-unit volume was calculated directly from the company costs supplied to the Commission. If labour is taken as 100 at the 20,000-unit level, it will be somewhat higher at the 10,000 level and higher still at the lower levels. Overhead costs were held constant between the 10,000 and 20,000 levels at 210 per cent. For the 5,000-unit level, they were increased to 223 per cent, and for the 500-unit single-purpose plant to 260 per cent. For the 500-unit multi-purpose plant, the intermediate level of 225 was taken.

Below a volume of 10,000 units, and certainly below 5,000, the use of an assembly line becomes more difficult or completely ineffective. The slow pace required to produce so few, or the batch system between unrelated products, produces inefficiencies by requiring each worker to undertake many more operations.

Total Costs – Tables 7.13 and 7.14 record total costs of combine manufacturing at different volumes for the different operations and the various cost factors. It is apparent that

the stamping operation is most subject to economies of scale, and that machining is least affected by volume changes. This would apply only to the volume ranges and types of machining under consideration. As would be expected, overhead costs are more subject to change than other cost factors, with costs of materials changing least.

TABLE 7.13–INDEX OF ESTIMATED COSTS OF COMBINE MANUFACTURING OPERATIONS

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
a) With each operation compared to 20,000-unit volume costs = 100					
Machining	110.3	107.7	106.6	103.7	100.0
Stamping	182.2	155.8	141.6	123.3	100.0
Assembly	133.9	122.6	114.5	104.5	100.0
Finished parts	111.7	110.1	108.9	105.3	100.0
Total costs	128.4	120.2	115.4	108.0	100.0
b) With total costs at 20,000-unit volume = 100					
Machining	26.7	26.1	25.8	25.1	24.2
Stamping	33.3	28.5	25.9	22.5	18.3
Assembly	24.9	22.8	21.3	19.5	18.6
Finished parts	43.5	42.8	42.4	40.9	38.9
Total costs	128.4	120.2	115.4	108.0	100.0

Source: Commission estimates.

TABLE 7.14–INDEX OF ESTIMATED COSTS OF COMBINES BY COST FACTOR

	Annual Output of Combines				
	500				
	Single-Purpose	Multi-Purpose	5,000	10,000	20,000
a) With each factor compared to 20,000-unit volume costs = 100					
Materials					
Finished parts	111.7	110.1	108.9	105.3	100.0
Other materials	112.3	107.7	106.0	103.0	100.0
Total materials	111.9	109.3	108.1	104.6	100.0
Labour	126.8	116.4	108.7	104.7	100.0
Overheads	160.5	142.8	132.7	116.4	100.0
Total costs	128.4	120.2	115.4	108.0	100.0
b) With total costs at 20,000-unit volume = 100					
Materials					
Finished parts	43.5	42.8	42.4	41.0	38.9
Other materials	18.6	17.9	17.6	17.0	16.6
Total	62.1	60.7	60.0	58.0	55.5
Labour	19.3	17.7	16.6	15.9	15.2
Overheads	47.0	41.8	38.8	34.1	29.3
Total costs	128.4	120.2	115.4	108.0	100.0

Source: Commission estimates.

In reviewing the estimation of cost changes relating to combine production volumes, it should be emphasized that these are very broad estimates, and should not be related directly to estimated real costs of production in particular plants. The fact that all estimates are based on the constant mix between "made" and "bought" parts at the 10,000-unit level makes them unreal by ignoring the largest source of cost reduction found in the tractor cost study–the shift from "bought" to "made" parts as volume increased. There is no reason to assume that similar cost reductions would not be found in combine manufacturing if the shift in make-buy decisions between the different volumes were fully analyzed.

Chapter 8

MARKET SHARES AND CONCENTRATION RATIOS

The strength of competition in any market is partially determined by the number and size of the firms that are competing with one another and by the ease with which new firms can enter. A market in which a small number of firms have the lion's share of the business is likely to be less competitive than one where sales are distributed among a comparatively large number of firms. A lower level of competition will often be reflected in higher prices and profit levels. If a few firms dominate the market, they will all be aware that a price that is higher than vigorous competition would allow will be profitable to all concerned. However, well-established firms are likely to take a longer-range view in their pricing, and often they will not raise their prices to take advantage of temporary shortages. Moreover, in setting their prices they may pay considerable attention to the risk that a high profit level might attract new competitors into the industry. Thus the ease with which new firms can enter and gain a secure foothold in the industry will temper the pricing policies pursued by the dominant firms.

However, there is no simple relation between ease or difficulty of entry and the degree of concentration—that is, the extent to which the market is dominated by a small number of firms. Where entry is normally difficult, it may nevertheless take place if the entrenched companies pursue high-price policies, and thus the degree of concentration would be reduced. Yet if the larger firms have significant cost advantages over the smaller new entrants, prices and the profits of the larger firms may remain well above competitive levels. In contrast, if more moderate pricing policies are pursued by the larger firms, concentration may remain high, with the smaller new entrants not being encouraged.

Two instances of where high concentration ratios are accompanied by moderate prices may be cited. Britain has the lowest level of tractor prices in the world; yet the market is highly concentrated. Two firms, Ford and Massey-Ferguson, are reported to sell over 70 per cent of all the tractors sold in Britain. The situation for combines in West Germany is similar. Prices of combines there appear to be significantly lower than in most other countries. Yet Claas produces two-thirds of all the combines manufactured there and is believed to have a large share of the market.

A widely used measure of the extent to which any market is dominated by a few firms is the concentration ratio. The concentration ratio measures the percentage of the total sales made in a given market by, for example, the largest four, the largest eight, or the largest 20 firms in the industry. The particular number of firms used as a measure is to some degree arbitrary, except to the extent that some limits are set by the necessity to avoid disclosing confidential information. However, the largest four and largest eight firms have been widely used in other countries and, for the sake of comparability, will be used here as well. In addition, some attention will be given to the largest six firms and to the Big Three – the three firms that have had the largest share of total sales on the average over the past decade. Some comparisons will be made with the situations in the United States and a number of countries in Western Europe.

For Canada, the data used are sales of farm machinery as reported to the Dominion Bureau of Statistics. For the United States, sales data are not available and resort must be had to data on manufacturers' shipments. For Western Europe the data available are limited to tractors and are estimates of the total number sold by different companies.

Concentration Ratios in the Canadian Market

The extent to which the Canadian market is dominated by the major full-line companies has declined appreciably since the late twenties and early thirties. In that period it was estimated that the four largest firms had 76 per cent of the total market. By 1967 the share of the four largest firms had fallen to 51 per cent and even the eight largest firms had just 71 per cent of the market (see Table 8.1). On a regional basis, the share of the four largest firms in 1967 varied from a low of 44.1 per cent in Ontario to a high of 63.6 per cent in the Atlantic Provinces. For the eight largest firms the variation was from 64.1 per cent in Ontario to 84.3 per cent in Saskatchewan. Concentration ratios for both Ontario and Quebec are appreciably below the national average. This probably reflects the more varied nature of agricultural production in these provinces, which attracts to the market a number of short-line firms selling specialized equipment. The comparative closeness of these two provinces to the major centres of farm machinery production in the United States undoubtedly encourages the entry of short-line firms. In contrast, the higher concentration ratios for the Atlantic Provinces and British Columbia may reflect the location and small size of these two markets. Over the past decade, sales of farm machinery in the Atlantic Provinces have amounted to only 3.0 per cent of the national total and in British Columbia to only 2.4 per cent.

Table 8.1 also indicates that the four largest firms are not always the same in all parts of the country. If we use the term "Big Four" to designate the four firms that have the largest sales in all Canada, we find that in the Atlantic Provinces, Quebec, and British Columbia, their share of sales is appreciably below the share of the four largest firms in each of these markets.

TABLE 8.1– CONCENTRATION RATIOS FOR FARM MACHINERY SALES, CANADA AND PROVINCES, 1967, AND PERCENTAGE OF TOTAL SALES ACCOUNTED FOR BY PROVINCES, 1957-67

	Percentage of New Farm Machine Sales Accounted for by			
	Four Largest Firms[1]	Big Four[2]	Eight Largest Firms[1]	Total Sales 1957-67
				(Per cent)
Canada	51.3	51.3	70.8	100.0
Atlantic Provinces	63.6	59.0	79.4	3.0
Quebec	50.3	36.3	69.9	12.4
Ontario	44.1	43.7	64.1	22.6
Manitoba	52.0	52.0	74.1	11.7
Saskatchewan	57.6	57.6	84.3	26.1
Alberta	59.7	59.7	81.5	21.7
British Columbia	61.4	55.3	81.6	2.4

[1] The columns headed "Four Largest Firms" and "Eight Largest Firms" include the group of four or eight companies which had the highest total sales in the area in question, Canada as a whole and in each province or region.

[2] The term "Big Four" is used to designate the four firms with the largest sales in Canada as a whole.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

An analysis of the changes in the market position of different firms over the past decade indicates that the "Big Three" have lost ground appreciably, with almost all of the loss occurring since 1963 (see Table 8.2). The Big Three are the three firms that have for many years been the three leading sellers of farm machinery in Canada–John Deere, International Harvester, and Massey-Ferguson (listed here in alphabetical order). About half of this recent loss by the Big Three has been picked up by the five firms that rank immediately below them and the remainder by still smaller firms. However, it must be recognized that there was a considerable change in the firms involved over this period. In particular, three firms that were operating indepently at the beginning of this period in 1957–Cockshutt, Oliver, and Minneapolis-Moline–were taken over by the White Motor Company in 1961 and 1962 and thereafter are considered as a single firm for the analysis here. In addition, C.C.I.L. fits rather uneasily into any concentration-ratio analysis; it was selling Cockshutt tractors and combines along with its own tillage and seeding equipment in the earlier part of the period, but after Cockshutt was taken over it began to sell European tractors and combines.

Concentration by Region – The decline in the degree of market concentration has varied across the country. The largest decline in the share of the four largest firms

TABLE 8.2–PERCENTAGE OF ANNUAL SALES IN CANADA OF FARM MACHINERY, INCLUDING REPAIR PARTS, ACCOUNTED FOR BY THE BIG THREE, AND BY THE SIX AND EIGHT LARGEST FIRMS, 1957-67

	Big Three	Six Largest Firms	Eight Largest Firms
1957	50	68	73
1958	50	69	74
1959	51	70	75
1960	50	70	74
1961	48	67	72
1962	50	69	74
1963	50	70	75
1964	49	69	75
1965	47	68	74
1966	44	65	71
1967	42	64	71

Note: The column headed "Big Three" includes Deere, International Harvester and Massey-Ferguson for all years. The columns headed "Six Largest Firms" and "Eight Largest Firms" include the group of six or eight companies which had the highest total sales in Canada each year; membership in the six and eight may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

occurred in British Columbia and Saskatchewan; the smallest, in Ontario and Quebec. The picture that emerges is one where the nine largest firms have retained about the same over-all share of the market, about 75 per cent, but where the market is somewhat more equally distributed among the different firms. In a rough way, we can say that the share of the four largest firms has fallen from an average of about 15 per cent per firm to around 13 per cent per firm and the share of the second four has risen from an average of 3.5 per cent to 5 per cent per firm. Further, it is clear that no single firm dominates the market to nearly the extent that International Harvester did in the late twenties, when it had about one-third of the total market. Moreover, this decline in the share of the four largest firms occurred despite White Motor's takeover of Cockshutt, Oliver, and Minneapolis-Moline. Taken by itself, this merger would have increased the share of the market taken by the four largest firms. But this was offset by the strong growth in sales enjoyed by a number of newer companies–in particular, Versatile, New Holland, C.C.I.L., and David Brown. The successful emergence of a number of new firms during the past decade provides considerable evidence that new entry is still possible in this industry. The market share of these four firms grew from 4 per cent in 1957 to 11.1 per cent of the Canadian market in 1967.

Concentration by Product – The degree to which sales are concentrated in the hands of the four largest and the eight largest firms also varies not only among different parts of Canada but also among different product lines. The concentration in a number of product lines is significantly higher than it is for farm machinery sales as a whole. Thus, as the data in Table 8.3 show, the concentration ratio is highest for combines and tractors, although the ratio for haying machinery is also comparatively high. The four largest firms have 68.6, 66.9, and 68.6 per cent, respectively, of the total Canadian sales of these products (see Table 8.3). For the eight largest firms the corresponding ratios are 93.4, 93.1, and 83.6 per cent. These three product groups accounted for about 65 per cent of the total market over the past decade. The lowest level of concentration occurs for tillage, cultivating, and weeding equipment. In 1967 the four largest firms had 42.4 per cent of this market and the eight largest firms 61.2 per cent.

TABLE 8.3–CONCENTRATION RATIOS FOR FARM MACHINERY IN CANADA, BY PRODUCT GROUPS, 1967, AND PERCENTAGE OF TOTAL SALES ACCOUNTED FOR BY PRODUCT GROUPS, 1957-67

	Percentage of New Farm Machinery Sales Accounted for by		
	Four Largest Firms	Eight Largest Firms	Total Sales 1957-67
			(Per cent)
Tractors	66.9	93.1	35.8
Combines	68.6	93.4	16.3
Swathers and windrowers	60.3	88.5	3.6
Haying machinery	68.6	83.6	12.6
Plows	59.6	76.1	5.1
Tillage and cultivating machinery	42.4	61.2	5.9
Planting, seeding and fertilizing machinery	62.9	71.2	4.1
All other machinery			16.4

Note: The columns headed "Four Largest Firms" and "Eight Largest Firms" include the group of four or eight companies which had the highest total sales in Canada as a whole in each product group; membership in the four or eight may vary among product groups.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales,* Cat. No. 63-203, various years.

There has also been a significant decline in the extent to which the Big Three dominate the market for different products. For a number of product groups, there was an appreciable decline in the market share of the eight largest firms as well,

TABLE 8.4–PERCENTAGE OF ANNUAL SALES OF SWATHERS AND WINDROWERS; HAYING MACHINERY; PLOWS; TILLING, CULTIVATING, AND WEEDING MACHINERY; AND PLANTING, SEEDING AND FERTILIZING MACHINERY; IN CANADA, BY BIG THREE, AND BY THE FOUR, SIX, AND EIGHT LARGEST FIRMS, 1957-67

	Big Three	Four Largest Firms	Six Largest Firms	Eight Largest Firms	Big Three	Four Largest Firms	Six Largest Firms	Eight Largest Firms
	A. Swathers and Windrowers				B. Haying Machinery			
1957	50	83	92	–	46	68	78	82
1958	54	77	90	95	53	67	79	83
1959	39	73	91	95	49	67	78	82
1960	35	76	94	96	49	68	80	83
1961	26	80	94	96	48	68	80	85
1962	34	78	90	92	51	71	82	86
1963	41	67	82	90	49	70	79	83
1964	36	63	82	90	47	71	80	85
1965	39	64	82	90	46	70	79	84
1966	35	61	78	88	45	70	78	83
1967	31	60	78	88	43	69	77	84
	C. Plows				D. Tilling, Cultivating, Weeding Machinery			
1957	58	67	77	83	56	66	72	76
1958	52	61	72	77	56	65	71	75
1959	52	61	71	76	54	62	70	74
1960	52	61	74	76	50	58	69	74
1961	50	59	71	74	42	51	63	70
1962	50	61	73	76	38	51	64	69
1963	50	61	76	79	38	47	61	65
1964	52	65	78	80	38	46	59	63
1965	52	66	77	80	35	45	57	63
1966	50	62	74	77	34	43	55	61
1967	46	60	72	76	32	42	55	61
	E. Planting, Seeding, Fertilizing Machinery							
1957	55	69	77	78				
1958	58	65	74	80				
1959	56	62	72	79				
1960	57	64	73	77				
1961	53	60	68	74				
1962	58	66	75	80				
1963	62	69	76	79				
1964	62	70	75	78				
1965	62	70	75	78				
1966	57	63	68	71				
1967	56	63	68	71				

Note: The column headed "Big Three" includes Deere, International Harvester and Massey-Ferguson for all years. The columns headed "Four Largest Firms", "Six Largest Firms", and "Eight Largest Firms", include the group of four, six, and eight companies which had the highest total sales of each product group in Canada as a whole in each year; membership in the group of four, six, and eight companies may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies's permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

indicating that the smaller firms below this level had increased their share of the market. Between 1957 and 1967 the share of the four largest firms in sales of tillage and cultivating equipment declined by 24 percentage points, and the share of the eight largest firms declined 15 percentage points. This means that firms ranking fifth to eighth in size increased their share of the market by 9 percentage points and still smaller firms by 15 percentage points. Another major decline in the share of the top four, 16 percentage points, occurred in combine sales. But here most of the decline was acquired by the four firms in the fifth to eighth category. Their share rose by 13 points from 11 per cent to 24 per cent. The four largest firms also lost ground in tractors, with a decline of 5 percentage points; in swathers, with a decline of 23 points; in plows, with a decline of 7 points; and in planting, seeding, and fertilizing equipment, with a decline of 6 points. Only for haying equipment did the share of the four largest firms increase, and then only by 1 per cent. For some products, such as tractors and swathers, much of this loss in the share of the four largest firms occurred during the last half of the decade, between 1962 and 1967. However, for other products it was spread over the entire decade (see Tables 8.4, 8.5 and 8.6). In a number of product lines the four leading firms in 1967 were not the same as the four leading firms in 1957.

TABLE 8.5–PERCENTAGE OF ANNUAL SALES OF COMBINES IN CANADA, BY BIG THREE, AND BY THE FOUR, SIX, AND EIGHT LARGEST FIRMS, 1957-67

	Big Three	Four Largest Firms	Six Largest Firms	Eight Largest Firms
1957	61	85	94	97
1958	64	83	96	98
1959	66	81	96	98
1960	64	84	95	97
1961	68	86	99[1]	99[1]
1962	65	79	96	98
1963	62	77	93	98
1964	62	75	91	96
1965	61	73	91	96
1966	56	69	86	94
1967	55	69	86	93

[1]Total figure published by Dominion Bureau of Statistics not complete because of disclosure rule. Percentages shown based on this incomplete total.

Note: The column headed "Big Three" includes Deere, International Harvester and Massey-Ferguson for all years. The columns headed "Four Largest Firms", "Six Largest Firms", and "Eight Largest Firms" include the group of four, six, and eight companies which had the highest total sales in combines in Canada as a whole in each year; membership in the group of four, six, and eight companies may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

TABLE 8.6 PERCENTAGE OF ANNUAL SALES OF WHEELED TRACTORS IN CANADA, BY BIG THREE, AND BY THE FOUR, SIX, AND EIGHT LARGEST FIRMS, 1957-67

	Big Three	Four Largest Firms	Six Largest Firms	Eight Largest Firms
1957	62	72	86	92
1958	60	70	85	93
1959	60	74	87	92
1960	57	69	85	91
1961	57	68	85	91
1962	60	72	88	94
1963	60	72	89	94
1964	59	72	89	95
1965	55	70	89	94
1966	54	69	89	94
1967	51	67	87	93

Note: The column headed "Big Three" includes Deere, International Harvester and Massey-Ferguson for all years. The columns headed "Four Largest Firms", "Six Largest Firms", and "Eight Largest Firms" include the group of four, six, and eight companies which had the highest total sales in tractors in Canada as a whole in each year; membership in the group of four, six, and eight companies may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales,* Cat. No. 63-203, various years.

The changes, shown in some detail in Tables 8.4, 8.5, and 8.6 are summarized in the following tabulation:

Change in Market Shares (in Percentage Points)

	1957 to 1967		1962 to 1967	
	Four Largest Firms	Eight Largest Firms	Four Largest Firms	Eight Largest Firms
Tractors	−5.0	+1.0	− 5.0	−1.0
Combines	−16.0	− 4.0	−10.0	−5.0
Swathers and windrowers	−23.0	− 7.0[1]	−18.0	−4.0
Plows	−7.0	− 7.0	−1.0	0.0
Planting, seeding and fertilizing machinery	− 6.0	− 7.0	− 3.0	−9.0
Haying machinery	+1.0	+2.0	− 2.0	−2.0
Tillage and cultivating machinery	−24.0	−15.0	− 9.0	−8.0

The share of the tractor market held by the four largest firms in individual provinces is appreciably larger than their share in Canada as a whole. This reflects the fact that the four largest firms are not always the same from one province to

[1] Change from 1958 to 1967.

another. For Canada as a whole the four largest sellers of tractors account for 66.9 per cent of total dollar sales in 1967 (see Table 8.7). Data for individual provinces are available only on a unit basis, and they are therefore not, of course, fully comparable with data in terms of dollars, because of the differences in prices and the different sizes of tractors used in particular areas. However, for wheeled tractors, and in terms of number of units sold, the four largest firms accounted for 73.9 per cent of total sales in Manitoba, 77.2 per cent in Saskatchewan and 71.3 per cent in Alberta. These ratios are significantly above the national total. However, the comparable ratios for the eight largest firms differ from the national ratios by much smaller amounts. For self-propelled combines also, the market share by regions for the four largest and eight largest firms are fairly close to the national totals.

TABLE 8.7–CONCENTRATION RATIOS FOR TRACTORS AND COMBINES, CANADA AND FIVE PROVINCES, 1967

	Wheeled Tractors (Units Sold)		Self-Propelled Combines (Units Sold)	
	Four Largest Firms	Eight Largest Firms	Four Largest Firms	Eight Largest Firms
Canada[1]	66.9	93.1	68.6	93.4
Manitoba	73.9	94.9	70.2	97.2
Saskatchewan	77.2	98.3	68.2	96.8
Alberta	71.3	95.9	66.9	97.4
Ontario	68.2	95.2	72.1	98.0
Quebec	74.0	92.1	81.8	n.a

[1]Data for all Canada are in terms of the dollar value of all tractors and combines sold.

Note: The columns headed "Four Largest Firms" and "Eight Largest Firms" include the group of four and eight companies which had the highest total sales in each product group in 1967 in Canada as a whole and in each province; membership in the group of four and eight companies may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

It is also instructive to examine the changes that have occurred in the market shares of the four and eight largest firms for different size groups of tractors over the past decade. The 10-year period 1957 to 1967 witnessed the introduction and rapid adoption of very much larger tractors. The larger tractors were first introduced by a few firms and then in subsequent years adopted by an increasing number of firms, so it is not surprising to find that the market share of the four largest firms in the larger horsepower ranges of tractors was at first very large but subsequently declined appreciably. However, in 1967, the share of the four largest firms in the two largest tractor size groups–70 to 99 HP and 100 HP and over, 84.1 per cent

and 81.4 per cent, respectively–was still substantially higher than their share for all tractors. The share of the market held by the four largest firms is also comparatively higher for small tractors of 39 HP or less. It is lowest in the 40 to 59 HP size group. Detailed data for 1962 to 1967 are given in Table 8.8.

TABLE 8.8–CONCENTRATION RATIOS FOR WHEELED TRACTORS, BY SIZE CLASS, CANADA, 1962-67

	1962	1963	1964	1965	1966	1967
Under 40 HP						
Four largest firms	88.0	89.4	90.8	88.8	86.4	86.7
Eight largest firms	96.6	–	97.9	96.9	96.4	97.0
40 to 59 HP						
Four largest firms	65.0	67.5	61.1	57.5	60.4	58.6
Eight largest firms	93.9	96.7	92.0	91.0	89.9	84.5
60 to 69 HP						
Four largest firms	90.1	85.7	79.0	76.0	75.7	68.5
Eight largest firms	100.0	99.0	97.6	98.5	–	99.3
70 to 99 HP						
Four largest firms	88.0[1]	87.9[1]	97.3	94.2	80.3	84.4
Eight largest firms						
100 HP and over						
Four largest firms			97.3	94.8	85.7	81.7
Eight largest firms						

[1] Includes all tractors 70 HP and over.

Note: The lines showing "Four largest firms" and "Eight largest firms" include the group of four and eight companies which had the highest total sales in the horsepower groups indicated in Canada as a whole in each year; membership in the two groups may therefore vary from year to year.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

Canada and the United States

It would also be desirable to compare the concentration ratios in the Canadian farm machinery industry with those in the comparable industry in the United States. Unfortunately, no data for the United States are available that are precisely comparable to those for Canada. However, concentration ratios are available for manufacturing shipments of farm machinery in the United States. These will differ from domestic sales data because they include export shipments, estimated to have amounted to around 12 per cent of U.S. factory shipments in 1963, and they make no allowance for imports, which amounted to about 6 per cent of total U.S. factory shipments in 1963. Moreover, the shipments data include

parts as well as wholegoods. In the comparison which follows in Table 8.9 some allowance must be made for these differences.

TABLE 8.9–CONCENTRATION RATIOS FOR FARM MACHINERY AND EQUIPMENT, CANADA AND THE UNITED STATES COMPARED, SELECTED YEARS

		Value of Sales (Canada) or Factory Shipments (United States) Accounted for by			
		Canada		United States	
		Four Largest Firms	Eight Largest Firms	Four Largest Firms	Eight Largest Firms
		(Per cent)			
Total farm machinery	1967	51	71	–	–
	1963	58	75	42	55
	1958	58	74	44	58
Wheeled tractors	1967	67	93	–	–
	1963	72	94	72	95
	1958	70	93	72	96
Planting, seeding and fertilizing machinery	1967	63	71	–	–
	1963	69	79	48	61
	1958	65	80	63	76
	1954	–	–	52	66
Plows, listers, harrows, etc.	1967	–	–	–	–
	1963	–	–	50	64
	1958	–	–	54	65
Harvesting machinery	1967	61	92	–	–
	1963	72	97	69	80
	1958	83	97	70	81
	1954	–	–	66	82
Haying machinery	1967	69	84	–	–
	1963	70	83	74	86
	1958	67	83	72	84
	1954	–	–	73	87
Tillage, cultivating and weeding machinery	1967	42	61	–	–
	1963	47	65	–	–
	1958	65	75	–	–

Note: For Canada, the columns headed "Four Largest Firms" and "Eight Largest Firms" include the group of four and eight companies which had the highest total sales of the product group in Canada as a whole in each year. For the United States these columns include the group of four and eight companies which had the highest total value of production of the product group in the United States as a whole in each year; membership in the four and eight may therefore vary from year to year and among product groups.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

U.S. Department of Commerce, Bureau of the Census, *Concentration Ratios in Manufacturing Industry*, 1963, Part I, Table 4, p. 210.

Inclusion of imports would probably make U.S. concentration ratios at the sales level somewhat lower than they are at the manufacturing level. The difference would be greatest for harvesting equipment, due to extensive U.S. imports of combines from Canada. The effects of the failure to exclude exports are more difficult to assess. If exports were the same proportion of shipments for firms at all size levels, concentration ratios would not be affected by whether exports were included or not. However, no data are available to indicate how the ratio of exports to total shipments varies with size of firm.

Within these limitations, a comparison of concentration ratios for the farm machinery industry is given in Table 8.9. These data show that the sale of farm machinery is more highly concentrated in Canada than it is in the United States. In 1963 the four largest firms accounted for 58 per cent of total sales of farm machinery in Canada. This compares with 42 per cent for the share of the four largest firms in total factory shipments of farm machinery in the United States. The comparable figures for the eight largest firms are 75 per cent for Canada and 55 per cent for the United States. Since 1963 there has been an appreciable decline in the share of the four and eight largest firms in Canada. The Commission has not determined whether a similar decline has occurred in the United States.

To some degree a lower concentration ratio can be expected for a country with a larger and much more varied agricultural industry. One or more of the four and eight major firms frequently may not produce many specialized types of equipment. And in the United States, because of the great variety of soils, crops and climatic conditions, these specialized products are more numerous. Support for this thesis is provided by the fact that in the case of the industry's major product, tractors, the concentration ratios in the two countries are very similar. In 1963 the ratios were identical at the four-firm level, the four largest firms accounting for 72 per cent in each case, and were very close at the eight-firm level, 95 per cent for the United States and 94 per cent for Canada. For haying machinery, concentration ratios for Canada were slightly lower, 70 per cent compared with 74 per cent in the United States at the four-firm level, and 83 versus 86 per cent at the eight-firm level. In contrast, although the classifications are not fully comparable, concentration ratios at the four- and eight-firm level for Canada were appreciably higher than those in the United States for planting, seeding, and fertilizing equipment, and for harvesting equipment. However, as was pointed out above, the inclusion of imports would significantly reduce the U.S. ratio for harvesting equipment. Massey-Ferguson and White Motor both import from Canada all the combines they sell in the United States, and Ford now imports and sells the Claas combine. In addition, the International Harvester plant at Hamilton produces an extensive line of planting and seeding equipment for the entire North American market.

Concentration in Western Europe

Estimates of the concentration in the sale of farm tractors are available for 1964 for Britain, France, West Germany, Italy, and Sweden.[1] The British market is highly concentrated. The three largest firms sold 80 per cent of all the tractors in Britain in 1964, with Ford and Massey-Ferguson together accounting for 72 per cent of the total. However, for these two firms, sales in Britain are a comparatively small part of their manufacturing output in that country. Most of the tractors they produce in England are exported.

In Italy, too, sales are highly concentrated, with Fiat, a local producer, accounting for nearly half of the total. Massey-Ferguson comes second with an estimated 12.3 per cent of the total market. However, the rest of the market is shared by a large number of different firms.

The Swedish market for tractors as well is highly concentrated. Again, a local firm, Volvo, is the leading seller with an estimated 40 per cent of the market. Massey-Ferguson is second with some 29 per cent of the market. Massey-Ferguson tractors in Sweden are sold through a distributor, rather than directly through the company's own wholesale distribution network as in most other countries.

The French market was less concentrated than that of the above three countries. The three largest sellers in France were Massey-Ferguson, Renault, and International Harvester. Together they accounted for 53 per cent of sales in 1964. The major domestic producer, Renault, like Volvo and Fiat, an automobile manufacturer as well, came second with about 19 per cent of the French market. The remaining sales were distributed among a comparatively large number of companies—a dozen or more.

Sales in West Germany, too, were much less concentrated, with the three largest sellers accounting for only 44 per cent of the total. Two of the three leading sellers were domestic firms, with Deutz (Klöckner-Humboldt-Deutz), a large manufacturer of diesel engines, accounting for 21 per cent of total sales, and Fendt 11 per cent. As in France, the rest of the market is divided among a comparatively large number of firms (see Table 8.10).

Some approximate estimates are also available of the share of each of the major firms in the North American market for farm machinery (see Table 8.11). These data indicate that Deere and International Harvester dominate the market, accounting for more than two-fifths of total sales. They are followed by Massey-Ferguson, Allis-Chalmers, White Motor, and Case. The total sales in North America of these latter four firms, taken as a group, are only about equal to those of Deere.

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[1] Donaldson, Lufkin & Jenrette, Inc., *The European Agricultural Equipment Industry and Competitive Positions of North American Producers* (New York: April 1966), Table VII, p. 10.

TABLE 8.10–PERCENTAGE OF TRACTORS SOLD IN VARIOUS WESTERN EUROPEAN COUNTRIES, ACCOUNTED FOR BY LARGEST COMPANIES, AND TOTAL NUMBER OF TRACTORS SOLD IN EACH COUNTRY, 1964

A. Britain

Tractors sold		31,000	
Massey-Ferguson	38.2%		
Ford	33.3		
International Harvester	8.0		
Three largest firms			79.5
British Leyland[1]	8.0[2]		
David Brown	4.0[2]		
Others	8.5[2]		20.5
			100.0

B. France

Tractors sold		82,000	
Massey-Ferguson	21.3%		
Renault	18.9		
International Harvester	12.8		
Three largest firms			53.0
Someca-Fiat	11.1		
Ford	10.1		
Deutz	6.4		
Deere-Lanz	2.6		
David Brown	2.3		
Fendt	.7		
Hanomag	.7		
Güldner	.7		
Eicher	.2		
Others	12.2		47.0
			100.0

C. West Germany

Tractors sold		81,000	
Deutz	20.8%		
International Harvester	12.2		
Fendt	11.1		
Three largest firms			44.1
Massey-Ferguson	7.9		
Eicher	7.0		
Deere-Lanz	6.8		
Hanomag	6.7		
Güldner	5.9		
Ford	4.3		
Renault	3.5		
David Brown	.6		
Someca-Fiat	.3		
Others	12.9		53.9
			100.0

D. Italy

Tractors sold		42,000	
Fiat	49.3%		
Massey-Ferguson	12.3		
Same	11.7		
Three largest firms			73.3
Ford	5.5		
Lamborghini	4.3		
Deutz	1.9		
Renault	1.5		
International Harvester	1.1		
British Leyland[1]	.9		
David Brown	.6		
Fendt	.5		
Others	10.4		26.7
			100.0

E. Sweden

Tractors sold		13,000	
Volvo	39.9%		
Massey-Ferguson	28.7		
Ford	9.5		
Three largest firms			78.1
British Leyland[1]	6.1		
David Brown	5.2		
International Harvester	4.6		
Others	6.0		21.9
			100.0

[1] Shown in source as "Nuffield".

[2] Interpolated from original estimates of 7-10 per cent, 3-6 per cent, and 5-7 per cent respectively for British Leyland Motor Corporation, David Brown, and Others in source.

Source: Donaldson, Lufkin & Jenrette, Inc., *The European Agricultural Equipment Industry and Competitive Positions of North American Producers* (New York: April 1966), Table VII, p. 10.

TABLE 8.11–SHARE OF NORTH AMERICAN FARM MACHINERY MARKET, LEADING FIRMS, 1967

	Estimated Total North American Sales of Farm Machinery[1]	Percentage of Total
	(Thousands of U.S. dollars)	
Deere	780,000	23.5
International Harvester	591,000	17.8
Massey-Ferguson	301,000	9.1
Allis-Chalmers	203,000	6.1
White Motor	189,000	5.7
J. I. Case	180,000	5.4
Others	1,074,318	32.4
Total	3,318,318	100.0

[1]The company sales figures and the figure for total North American sales are at Net Selling Prices to the dealer, i.e. 73 per cent of Company Suggested Retail Prices.

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table E. 2.

Chapter 9

COMPETITIVE BEHAVIOUR

Farm machinery firms compete on price and in various non-price ways. Non-price competition may include an emphasis on product quality, development of new products, the way dealerships are established, the quality of service provided through the dealer organization, advertising, and the provision of various ancillary services such as credit. This chapter will first examine price competition in the industry and then consider some forms of non-price competition. Other forms of non-price competition will be considered in more detail in later chapters.

A number of different companies described, either in their briefs or in the Commission hearings, the way in which they set prices on various products. Since sales are highly seasonal, prices are usually reviewed annually and any changes are announced during the off-season. Prices are established after careful comparison with the competitive machines of other companies. As described by one company, this comparison covers quality, performance, customer acceptance, special features offered, horsepower and travel speed for self-propelled machines, output for implements, grain losses for combines, complexity of repairs and maintenance, expected machine life, convenience to the operator, and any other characteristic that can be quantified to some degree. Each of these features is given a value relative to the company's own machine, and the sum of these plus and minus values are then compared with the difference in price. An underlying consideration is the need to cover production and development costs and earn a return on invested capital. Where a company has developed a distinctively new machine that has a potential for reducing farm production costs, one factor in setting prices will be the saving the machine provides in comparison with its less-up-to-date competitors.

A Model of Competitive Behaviour

In an industry such as farm machinery, where the three largest firms share 40 to 50 per cent of the market for most products, there is some reason to believe that the dominant firms will be reluctant to compete actively

on price. Smaller firms are likely to place more stress on price competition. Consider the price and cost situation facing firms in this industry. On the average, costs that vary directly with output–such as labour, materials, and supplies –account for about 45 per cent of the companies' dealer selling price. The remaining 55 per cent goes to cover various fixed or overhead costs–such as salaries, depreciation, and development costs–and to provide a profit. Given this cost picture, if the company is to gain from a 10 per cent price cut on one of its products, it must obtain a sales increase of more than 22 per cent.[1]

This relationship is illustrated in Figure 9.1 which shows a break-even analysis for a firm whose total revenue just covers total costs, including profits, at an output of 100 units. A 10 per cent price reduction would cause the total revenue line to shift down by 10 per cent. It would now intersect the total cost line at an output of 122. Thus an increase in sales (in quantity terms) in excess of 22 per cent would be required in order to make the price reduction profitable. As is evident from the diagram, this analysis assumes constant marginal and average costs.

With a 22 per cent sales increase, profits would be unchanged. For the industry's products as a whole, some studies indicate that the elasticity of demand is about 1.0–that is, a 10 per cent price cut will yield about a 10 per cent increase in sales. Thus if the price-cutting firm is to obtain a sales increase of more than 22 per cent, it will have to take sales away from other firms. If the firm is large, a price cut may well cause its competitors to cut their prices as well. And if all firms cut prices by 10 per cent, they will end up with substantially lower profits, assuming this leads to only a 10 per cent increase in over-all purchases by farmers. Indeed, in terms of the industry's average ratio of profit to sales, about 8 per cent on a before-tax basis, a 10 per cent price cut would reduce industry profits by about two-thirds.

Some quantitative dimension is given to this picture by the following data, which show the effects on the sales and profits of the rest of the industry that would be caused by a 10 per cent price cut by a dominant firm–assuming that the price cut produced the required 22 per cent increase in the firm's sales, and that demand for the industry's product has an elasticity of 1.0.

In interpreting these data it may be noted that for most product lines, each of the three dominant firms in the industry has from 10 to 20 per cent of the total market. For four product lines, the market share of one of these firms exceeds 20 per cent. In another four the share falls below 10 per cent. This pattern would be more dispersed if individual models and sizes of products were considered.

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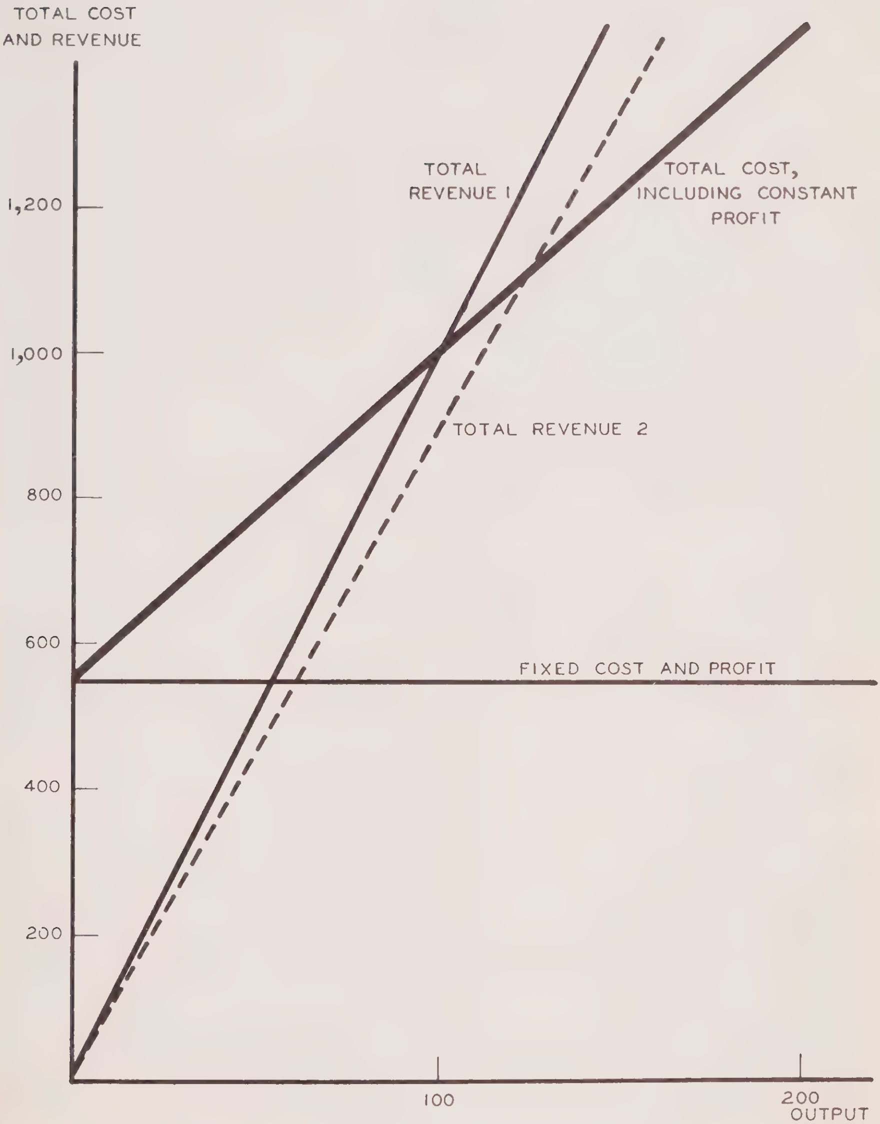
[1] For a more detailed discussion of this point, see D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Ch. 6, Table 6.1.

FIGURE 9.1–EFFECTS OF PRICE CUT AND VOLUME ON PROFITS: BREAK-EVEN ANALYSIS



Market Share of Dominant Firm	Effects of a 10 Per Cent Price Cut by Dominant Firm, Producing a 22 Per Cent Sales Increase, on the Sales and Profits of Other Firms	
	Sales	Profits Before Tax
Per cent	Per cent	Per cent
33	−6.0	−41
25	−4.0	−27
20	−3.0	−21
15	−2.1	−10
10	−1.3	− 9
5	− .6	− 4

The data above show that if a firm with 20 per cent of the market for a given type of machine were to cut its price 10 per cent and gain a 22 per cent increase in sales, it would cause the sales of all other firms to fall an average of 3.0 per cent and their profits to fall 21 per cent. If the price-cutting firm's share were only 10 per cent, other firms would suffer a 1.3 per cent fall in sales and a 9 per cent decline in profits. These data suggest that the larger firms will be hesitant to cut prices because they can expect other firms to follow suit, and all firms would end up with lower profits. On the other hand, a small firm—say, one with 5 per cent of the market or less—may at times cut its price to increase its market share in the expectation that the effects of its price cut on other firms' sales and profits will be too small to cause them to retaliate. Since the comparative merits of the products of different firms is a matter of judgement, there will, of course, be considerable uncertainty as to the effects of any price cut. Given the model changes that take place periodically, there will always be some uncertainty as to the degree to which any price change is a readjustment in that firm's price relative to the prices of other firms, or the degree to which it is an adjustment to reflect changes in the quality and competitive merits of the product. The farm machinery firms reported to the Commission that they did not like their price to differ from those of their competitors by more than 5 per cent "either way". One firm suggested that a more realistic target was 2.5 per cent either way.

If small-scale firms secure a foothold in the industry, and if their costs are comparable to or lower than those of larger firms, they will be likely to use price cuts to expand their market share. In contrast, the larger firms are likely to prefer non-price forms of competition such as product improvement and the creation of a strong dealer organization. If the small firms continue to expand, and non-price competition by the larger firms proves ineffective in preventing this, the larger firms may retaliate by cutting prices. However, as was shown in Chapter 7 on economies of scale, for a number of products such as tractors and combines, there are significant cost economies obtainable through larger-scale production. Since the small firms cannot match the costs of the larger firms on these products, the

competition they can offer in this area is limited.[2] The larger firms may maintain prices that allow them to earn profits well above the competitive level without inviting the expansion of small firms or the entry of new firms. These prices will provide an umbrella under which the smaller firms can meet their higher costs. In these circumstances the industry will have prices and costs that are substantially higher than those that would prevail if all firms were operating at an optimum scale, yet the industry as a whole may not appear unduly profitable. The dominant firms may even prefer to keep prices at a level that attracts new firms and gradually reduces the dominant firms' share of the market, rather than a lower price level designed to keep new firms out of the industry. In effect, this means choosing high profits today—profits that are expected to decline gradually in the future—in preference to a lower, more stable profit level.

In applying this model of price behaviour to the farm machinery industry, it is necessary to recognize that there can be many variations in detail. Individual attitudes may be important. It has been reported that the late Harry Ferguson believed in pricing his tractors at a level that provided very little profit, relying on his sales of other complementary machinery to provide the bulk of his profit, even though many of his executives urged him to raise his tractor prices. In the 1920s, when Henry Ford first entered the tractor market, he expanded his market share rapidly through aggressive price competition, only to lose sales rapidly a few years later as a result of innovations introduced by International Harvester and other firms. Larger firms often favour competition through product innovation, partly because there are economies in research obtainable by larger firms, and partly because the effects of successful innovation can be less easily and quickly duplicated than a price cut.

Market Shares

The three major firms in the farm machinery industry in Canada are Massey-Ferguson, John Deere, and International Harvester. Although the relative position of these three firms has changed over the years, their over-all dominant position has been maintained for a long time. However, over the past decade their combined share of the Canadian market has fallen in every major product line with one exception—planting, seeding, and fertilizing equipment. Between 1957 and 1967 their share of the tractor market fell from 62.0 per cent to 50.6 per cent, their share of the combine market from 61.2 to 55.1 per cent, their share of swather sales from 50.1 to 30.7 per cent, of haying equipment from 46.5 to 43.4 per cent, of plows from 58.2 to 45.8 per cent, and of tilling, cultivating, and weeding equipment from 55.9 to 32.4 per cent (Table 9.1). What has accounted for this significant decline in the market share of the Big Three? Has it been a policy of

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[2] Occasionally small firms may be able to take advantage of unusually low labour costs and offer effective competition to the larger firms in spite of their comparatively small volume. Versatile's entry into the production of tractors and combines is an example of this. See N. B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Ch. 5.

pricing at too high a level, thus permitting new firms to enter the industry? Has it been a failure to improve their product line with sufficient speed? Or has some other factor been responsible for their declining share? Consider each of the major product lines in turn.

TABLE 9.1 – SHARE OF CANADIAN FARM MACHINERY SALES ACCOUNTED FOR BY THE BIG THREE, BY PRODUCT LINES, 1957-67

(Percentage of total sales in Canada)

	Tractors	Combines	Swathers	Haying Machinery	Plows	Tilling, Cultivating, and Weeding Machinery	Planting and Seeding Machinery
1957	62.0	61.2	50.1	46.5	58.2	55.9	55.4
1959	59.7	65.5	39.1	49.2	51.9	53.6	55.7
1961	57.2	67.5	26.3	48.0	49.5	42.3	52.8
1963	60.1	62.1	41.0	48.9	49.7	38.2	61.8
1965	55.4	60.9	39.4	45.9	51.8	34.7	62.3
1966	53.7	56.1	35.1	45.0	49.9	34.1	56.8
1967	50.6	55.1	30.7	43.4	45.8	32.4	56.2

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

Tractors – The decline in the Big Three's share of the tractor market reflects gains by a number of smaller companies. Significant gains were made over the period from 1957 to 1967 by Case, David Brown, British Leyland and Deutz (sold by C.C.I.L.), and more recently by Versatile. Further light is thrown on these changes by an examination of data on the Big Three's share for different size groups of tractors. As Table 9.2 shows, their share of the smallest size group, under 40 HP, increased significantly over the decade ending in 1967. Unfortunately for the firms concerned, however, tractors in this size group have been a rapidly declining segment of the total market, accounting for 77 per cent of total dollar sales in 1957 but only 15 per cent in 1967. In contrast, the Big Three's share of the 40 to 59 HP size group, a group which accounted for only 23 per cent of the tractor market in 1957, has fallen very sharply from 81 per cent in 1957 to 35.9 per cent in 1967. Further, in the rapidly growing market for larger tractors (tractors of 60 HP or over accounted for 64.7 per cent of the value of all tractors sold by 1967), the Big Three's share has amounted to only about 50 per cent in recent years. Thus, in considerable measure, the failure of the Big Three to retain the market share they held in 1957 is related to their relative success or lack of it in developing and marketing the larger horsepower tractors which came increasingly into demand as the decade progressed. Case's increased market share must have been due in substantial measure to the customer acceptance gained for their larger horsepower

TABLE 9.2 – MARKET SHARE OF THE BIG THREE, TRACTORS, BY SIZE GROUP, 1957-67
(Percentage of total sales in Canada)

	Under 40 HP	40-59 HP	60-69 HP	70-99 HP	100 HP and Over
1957	58.5	81.0[1]			
1959	60.0	68.7[1]			
1961	62.5	44.1	43.9	76.5[2]	
1963	74.3	45.2	50.1	65.1[2]	
1965	73.2	35.1	47.3	63.7	53.0
1966	70.4	34.4	51.8	52.3	56.5
1967	69.5	35.9	45.8	49.6	53.4

[1] 40 HP and over.
[2] 70 HP and over.

Source: Company confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years.

models. Price data for the 1967 selling season suggest that although Case's larger tractors were priced competitively, the company was not using substantially lower prices to increase its market share. The increased market shares gained by David Brown and British Leyland undoubtedly reflect the use of price to gain a share of the market in the 40-59 HP class. In 1967 the tractors of these two companies were priced lowest on a per-horsepower basis of the 13 tractor models offered in the 45 to 60 HP group.[3]

Prices and costs of tractors were examined on a broad international basis in the Commission's *Special Report on Prices of Tractors and Combines in Canada and Other Countries*. The emphasis in that report was on the price differences that exist between different countries. It will be useful here to review briefly some of the evidence presented in that report for the light it throws on the question of competitive behaviour.

As the data in Table 9.3 show, the three largest firms in the Canadian market account for about 60 per cent of U.S. wheeled tractor production and together with Ford for 74 per cent. Deere and International Harvester each have North American output levels of around 60,000 units per year. Output by Ford and Massey-Ferguson in the United States is lower than this, just under 40,000 for each company, but the North American tractor operations of both companies are primarily assembly.[4] As will be described in more detail in Chapter 14, both Ford and Massey-Ferguson's world tractor operations are highly integrated, with major components such as engines and transmissions each produced primarily in one

[3] Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Ch. 5.

[4] In a statement commenting on the Commission's *Special Report on Prices*, Massey-Ferguson estimated the average North American output over the period 1966-69 for three of these firms as follows: Massey-Ferguson, 32,000; John Deere, 56,000; and International Harvester, 52,000. Total output of all firms in North America was about 230,000.

TABLE 9.3–WORLD PRODUCTION OF WHEELED TRACTORS, ACTUAL AND ESTIMATED, 1966
(Except U.S.S.R., China, and East European Countries)

(Thousands of units)

Figures in italics are estimates

Company Ranking According to Market Share	World	U.S.A.	Britain	Federal Republic of Germany	France	Italy	Belgium	Sweden	Spain	India	Austria	Australia	Japan	Brazil	Finland	Others
Massey-Ferguson	153.8	38.8	78.6		29.2	3.2								4.0		
Ford	118.4	38.6	57.1				22.7									
International Harvester	*108.0*	*62.0*	*21.0*	*15.0*	8.5							*1.5*				
Deere	*78.0*	*60.0*		*18.0*												
Fiat (Fiat + Someca)	*41.5*				6.5	*35.0*										
Renault/Porsche	*19.0*				19.0											
David Brown	*18.5*		*18.5*													
J.I. Case	*17.5*	*17.5*														
Deutz	*17.0*			*17.0*												
Allis-Chalmers	*15.5*	*15.5*														
Brit. Leyland (Nuffield)	*15.0*		*15.0*													
Volvo	14.7							14.7								
Oliver (Cockshutt)	15.0	15.0														
Minneapolis-Moline	*7.0*	*7.0*														
Valmet	*4.0*													*.9*	3.1	
Other (known companies)	9.4								6.0	3.4						
Other (not identified)	*157.2*	*15.6*	*20.2*	*51.0*	2.1	*10.8*			7.1	8.6	11.7	*9.3*	9.7	*1.1*		*10.0*
World Total	*809.5*	270.0	210.4	101.0	65.3	49.0	22.7	14.7	13.1	12.0	11.7	10.8	9.7	*6.0*	3.1	*10.0*

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table 2.1.

location. On a world basis, in 1966 Massey-Ferguson produced 154,000 wheeled tractors and Ford 118,000. Aside from the above four, and with the exception of Fiat which had an output in Italy of 35,000 in 1966, all the remaining tractor producers in the non-Communist world had a production of 20,000 units or less in 1966.

Thus, on the basis of the economies of scale described in Chapter 7, the four major tractor producers must clearly have very significant cost advantages over their smaller competitors. Further, there is evidence that tractor manufacturing costs in Britain are significantly lower than they are in North America. Consider each of these points in turn.

The fact that North American firms such as Case, Allis-Chalmers, and White Motor are able to survive with annual tractor output levels in the range of 10,000 to 20,000 in the face of competition of larger firms with output levels of 50,000 or more is very strong evidence that the prevailing level of tractor prices provides the larger firms with a very substantial profit on assets employed in manufacturing. As was shown in Table 7.2, a tractor selling price that would earn a company a return of 11.8 per cent at an output level of 20,000 units would yield an estimated 32.7 per cent at 60,000 and 44.8 per cent at 90,000. That this higher profit is not evident from profit data published in the companies' annual reports is due to the wide range of products manufactured by these companies and the large marketing inventories they carry. The profits earned by the industry are analyzed in some detail in Chapter 12.

The profitability of tractor prices varies not only with the level of annual output but also with the size of tractor. In general the evidence shows that larger-sized tractors are priced at a higher level in relation to estimated cost than is true for the smaller tractors. This relation between prices and costs at different output levels and tractor sizes is summarized in Table 9.4 and Figure 9.2. As these data show, on the basis of tractor prices prevailing in Canada during the 1967 selling season, for the 40 HP tractor a North American manufacturer would incur a loss at annual output levels of 20,000 and 60,000 and would earn only a small return over manufacturing cost with an output of 90,000. In fact, most of the tractors sold in this size range in Canada are manufactured in Western Europe, where cost levels are lower. In contrast, the prices for the larger-horsepower tractors yield a very substantial gross margin over manufacturing cost even for a firm with an output level of 20,000 units. For example, on the 90 HP tractor the average net wholesale (dealer) price in 1967 would yield a gross margin of 32.6 per cent at an output level of 20,000, 40.6 per cent at 60,000, and 45.7 per cent at 90,000. This compares with an average gross margin for the industry on all products of about 20 per cent (see Table 12.6).

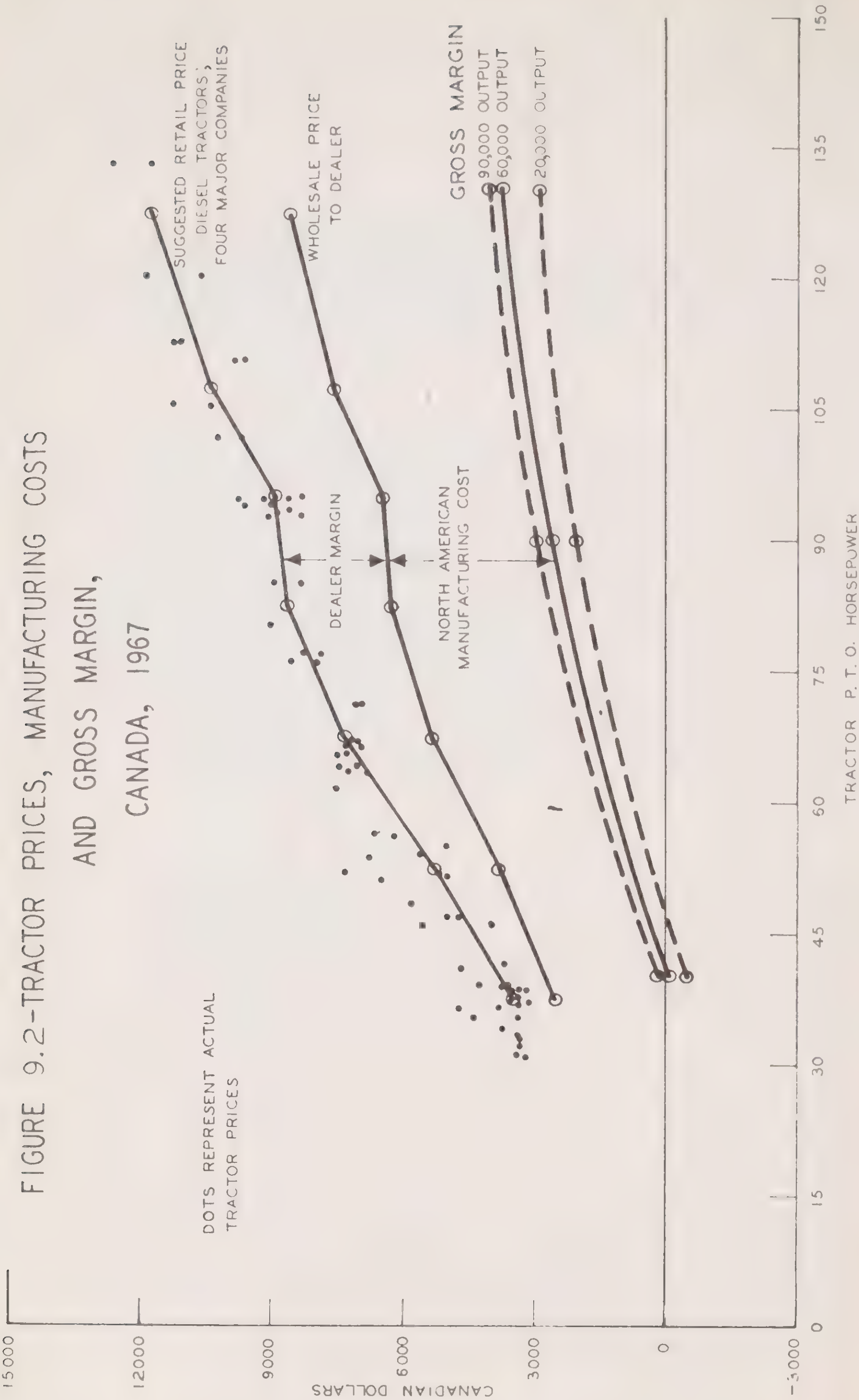

FIGURE 9.2—TRACTOR PRICES, MANUFACTURING COSTS AND GROSS MARGIN, CANADA, 1967

TABLE 9.4–GROSS MARGIN FOR DISTRIBUTION AND OTHER COSTS INCLUDING PROFIT, BY SIZE OF TRACTOR AND LEVEL OF ANNUAL OUTPUT, NORTH AMERICAN TRACTOR MANUFACTURING COSTS

(Canadian dollars)

	Size of Tractor		
	40 HP	90 HP	130 HP
Net wholesale price (NWP)	2,669	6,307	8,835
20,000 Annual Output			
Manufacturing cost	3,194	4,254	5,748
Gross margin[1]	-525	2,053	3,087
Gross margin as percentage of NWP	-19.7	32.6	34.9
60,000 Annual Output			
Manufacturing cost	2,812	3,746	5,061
Gross margin[1]	-143	2,561	3,774
Gross margin as percentage of NWP	-5.4	40.6	42.7
90,000 Annual Output			
Manufacturing cost	2,572	3,426	4,629
Gross margin[1]	97	2,881	4,206
Gross margin as percentage of NWP	3.6	45.7	47.6

[1]Gross margin equals price to dealer (Net Wholesale Price) less manufacturing cost.

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table 6.4, p. 66.

By concentrating their output in the larger-size range, the smaller firms have been able to earn a good return on their manufacturing investment, even though their manufacturing costs per tractor (at 20,000 units per year) are some 13 to 14 per cent higher than they are for a firm with an output of 60,000 and some 24 per cent higher than they would be at a 90,000-unit level. These smaller firms have been able to survive in the tractor manufacturing field only because the larger firms, such as Deere and International Harvester, have chosen to price their larger tractors at a comparatively high level in relation to costs. These conclusions are based on estimated manufacturing costs in new plants incorporating the latest proven technology. Costs in existing plants may depart from this in varying degrees.

A comparison of North American and British tractor manufacturing costs suggests that British costs are currently about 25 per cent lower than those in North America. Estimated unit costs for three different output levels are presented in Table 9.5 and shown in chart form in Figure 9.3. Further, as was documented in detail in the Commission's *Special Report on Prices,* these lower costs are paralleled by lower tractor prices in the British market. However, these lower prices may still yield to the larger-volume producers in the British market, such as Ford and Massey-Ferguson, a return on capital in the range of 20 to 25 per cent, or even

higher on some models. This is well above the competitive level. Estimates of the profitability of tractor manufacturing in Britain for the 1967 and 1968 selling seasons are given in Table 9.6.

TABLE 9.5 COMPARISON OF NORTH AMERICAN AND EUROPEAN TRACTOR MANUFACTURING COSTS AT ANNUAL OUTPUT LEVELS OF 20,000, 60,000, AND 90,000 AS OF 1967

(Canadian dollars)

	Cost per Average Tractor		
	20,000	60,000	90,000
U.S. cost (1968)[1]	4,189	3,688	3,374
British cost (1967-68) post-devaluation	3,164	2,759	2,490
British cost as percentage of U.S. cost	75.5	74.8	73.8

[1] Costs are for average mix of tractor sizes and models incorporated in the study by N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale,* Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969).

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table 6.6, p. 69.

Thus far, the lower price and cost levels for tractors prevailing in Britain have not spread to North America, although the import of European tractors has caused some softening of tractor prices in the lower-horsepower ranges in Canada.[5] Indeed, as was described in the Commission's earlier report, the companies have taken strong measures to prevent or limit the importation of tractors into North America from the lower-priced British market. Tractor prices in North America appear to be set by Deere and International Harvester who occupy a dominant position in the U.S. market, and who supply tractors to the North American market mainly from their North American production facilities. As was explained above, current prices for tractors on all the larger-horsepower models provide the large-volume North American producers with an attractive return on their manufacturing investment. The return to firms like Ford and Massey-Ferguson, who manufacture many of the components for their North American tractors in their lower-cost British facilities at relatively large volumes, should be still larger. Thus far, Ford and Massey-Ferguson have not elected to take advantage of their low-cost European source to bring tractor prices down in North America. Ford is a long-line rather than full-line firm in the North American market, and may not consider itself to be in a strong enough position to use tractor prices as a basis for expanding its share of the market. Massey-Ferguson's share of the rich U.S. market for farm machinery has been well below its share in many other markets. It is currently engaged in a major effort to expand and strengthen its product line in that market, particularly in the Corn Belt. Thus this company, too, may not feel strong enough to use tractor prices as a basis for expanding its share of the U.S. market.

[5] For a discussion of the current 1970 price situation between Canada and Britain, see the note appended to this chapter.

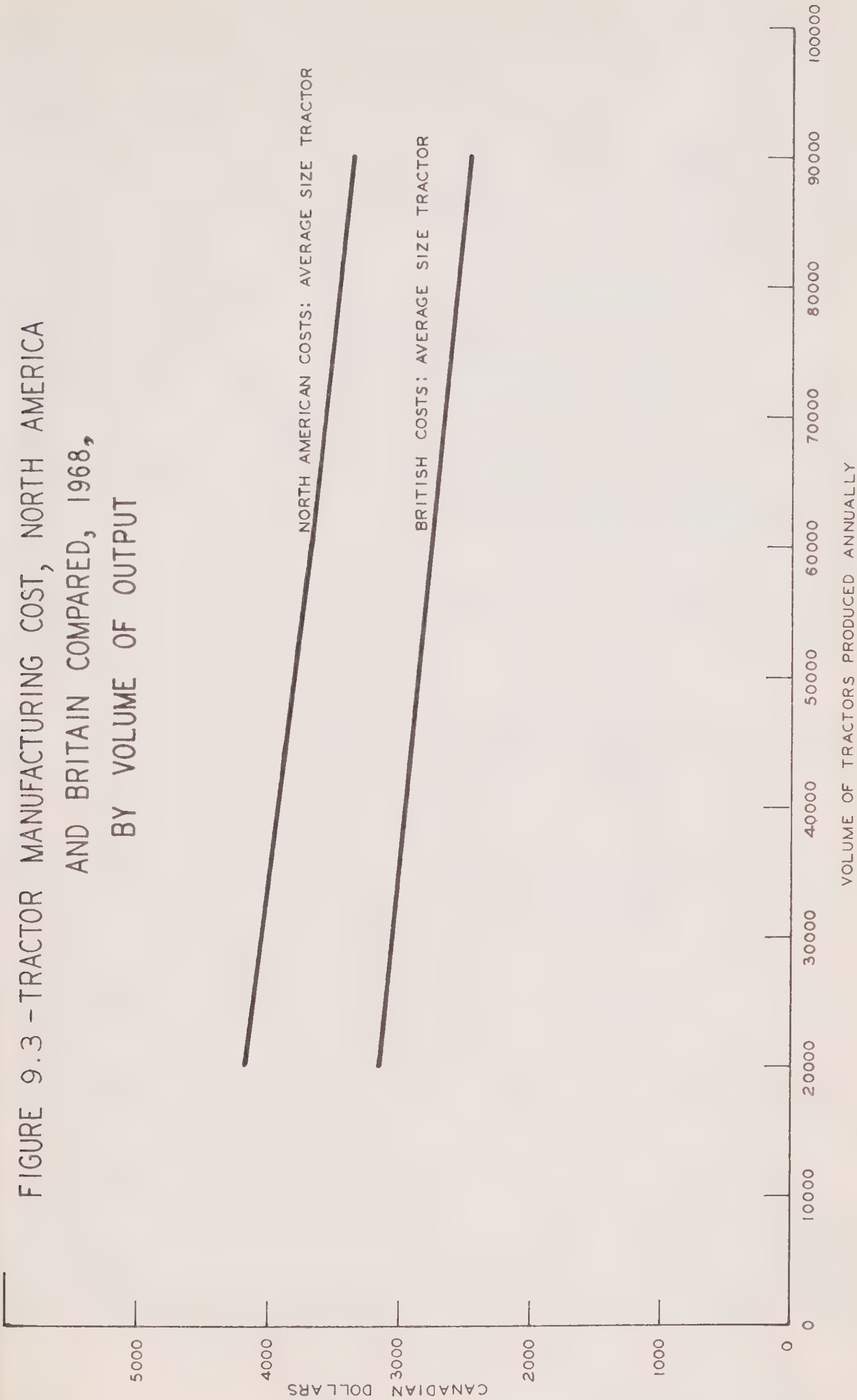

FIGURE 9.3 - TRACTOR MANUFACTURING COST, NORTH AMERICA AND BRITAIN COMPARED, 1968, BY VOLUME OF OUTPUT

TABLE 9.6–ESTIMATED PROFITABILITY OF TRACTOR MANUFACTURING IN BRITAIN, BASED ON BRITISH PRICES AND COSTS, 1967 AND 1968 SELLING SEASONS

	Index	1967	1968
Suggested retail price[1]	100	4,868	4,395
Less dealer discount[2]	18	876	791
Net price to dealer	82	3,992	3,604
Distribution margin[3]	21	1,023	923
Manufacturing price	61	2,969	2,681
Less R&D costs[4]	3	146	132
Net price to manufacturing division	58	2,823	2,549

	1967 Prices and Costs			1968 Prices and Costs		
Production Volume (Units)	20,000	60,000	90,000	20,000	60,000	90,000
Manufacturing selling price[5]	2,800	2,800	2,800	2,550	2,550	2,550
Manufacturing cost[6]	2,723	2,384	2,184	2,580	2,250	2,060
Manufacturing profit[7]	77	416	616	(30)	300	490
Total profits (millions)	1.5	25.0	55.4	(.6)	18.0	44.1
Assets employed (millions)	58.0	140.1	211.9	58.0	140.1	211.9
Profits as percentage of assets employed	2.7	17.8	26.9	(1.0)	12.9	20.8
Gross margin including 7.5%	10.2	25.3	34.4	6.5	20.4	28.3

Note: Method employed in arriving at above estimates:

[1] The suggested retail price was obtained by taking the average price per horsepower for tractors in the 35-45 HP group and multiplying this by the average size of tractor used in the study by N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Study No. 2 (Ottawa: Queen's Printer, 1969).

[2] A dealer discount of 18 per cent was used as typical of the British market.

[3] A distribution margin of 21 per cent was allowed. This gives the same transfer price from manufacturing to distribution as prevails in North America. This may well understate profits to the manufacturing division because of the lower dealer margin in Britain, and the compact character of the British market which should make distribution costs lower.

[4] Research and development costs were taken at 3 per cent of suggested retail price.

[5] Prices estimated in line 7 ($2,823 and $2,549) were rounded off.

[6] Manufacturing costs for different output levels based on data given in Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table D.13.

[7] Assets employed in the tractor factory were taken at the same level as estimated in the study cited above in Note 1, even though this probably overstates the value that an equivalent factory would have in Britain. In general, the estimates used are therefore likely to understate company profits.

There is also some reason to believe that the two dominant British manufacturers, Ford and Massey-Ferguson, may have been somewhat slow in moving into the larger-horsepower tractor market which has expanded so rapidly in North America during the past decade. Until recently, demand in the European and other markets has been mainly for smaller-horsepower models, and this may have led the companies whose production was mainly abroad to give less attention to the

larger tractors. The data in Table 9.7, which show the largest tractors offered for sale by each of eight major firms over the period 1949 to 1967, give some support to this view. Ford, for example, has been consistently behind the other firms in terms of the largest size of tractor offered for sale. Not until 1969 did they introduce a tractor with more than 67 HP. Massey-Ferguson has occasionally taken the lead, as it did in 1961 and 1962, but it has also often lagged significantly behind other major firms. For a period in the late fifties Oliver-Cockshutt offered the largest tractor. More recently, Deere has taken the lead.

The pattern of price competition in tractors is summarized in Table 9.8, comparing the average price per horsepower of the tractors offered for sale in 1967 by the Big Three and by other firms. Where more than one tractor appears in a given class the price is an average of the companies' different models. The table also shows for each class the three companies offering the lowest-priced tractor. The data support the view that some of the smaller firms have been using price competition to maintain or increase their market share. This is particularly true for Versatile whose large four-wheel-drive tractor is priced significantly below other tractors in this size group. It is true also of the two models sold by Minneapolis-Moline and the tractors sold by David Brown and British Leyland in the 45 to 60 HP group. There is evidence that White Motor, in particular, through its two subsidiaries, Cockshutt and Minneapolis-Moline, has placed considerable stress on price competition. In 1967, Cockshutt had the lowest-priced tractor in one group, the second lowest in two other groups, and the third lowest in still another group.

However, the pattern is not completely regular. The average price for the Big Three in the 30 to 45 HP group is lower than that of any of the other companies, suggesting that in this category the major firms place considerable stress on price competition. In addition, Deere has the lowest-priced tractor in the 90 to 100 HP category and the second lowest in the 115 and over category. Both Deere and Massey-Ferguson saw their share of the Canadian tractor market decline significantly between 1963 and 1967. International Harvester and White Motor more or less held their own, while Case and Versatile increased their market shares appreciably. Price competition undoubtedly played some part in these changes. But the timing and market acceptance of the new higher-horsepower models must also have been an important factor.

Combines – The share of the Big Three in the Canadian combine market declined from 61.2 per cent in 1957 and 67.5 per cent in 1961 to 55.1 per cent in 1967. Much of this decline has been due to the growth in sales of three companies – Versatile, New Holland, and C.C.I.L. Versatile entered the combine market for the first time in 1964, and New Holland in 1965. Versatile sells a combine of its own design. New Holland's combine is basically the Clayson combine produced in Belgium, a combine which had been sold on the Prairies in the early sixties by C.C.I.L. The latter company subsequently began to sell the Claas combine which is manufactured in West Germany. Ford has now taken over the distribution rights for this company throughout North America, and C.C.I.L. has begun to distribute

TABLE 9.7–LARGEST HORSEPOWER SIZE OFFERED FOR SALE, WHEELED TRACTORS, MAJOR MANUFACTURERS, 1949-69

	Allis-Chalmers	Case	Deere	Ford	International Harvester Company	Massey-Ferguson	Minneapolis-Moline	Oliver-Cockshutt
1949	27.6	22.3	51.0	26.4	22.2	**61.4**	48.8	45.0
1950	35.8	22.3	51.0	27.3	53.2	**61.4**	59.5	45.1
1951	35.8	22.3	51.0	27.3	53.2	**68.2**	59.5	45.1
1952	35.8	61.8	51.0	27.3	53.2	**68.2**	59.5	57.8
1953	45.4	64.8	51.0	40.6	53.2	**68.2**	59.5	57.8
1954	45.4	64.8	51.0	40.6	67.2	**68.2**	59.5	58.1
1955	45.4	64.8	67.6	46.9	67.2	68.2	68.5	**83.5**
1956	45.4	64.8	67.6	46.9	67.2	68.2	68.5	**83.5**
1957	45.4	64.8	75.6	46.9	67.2	68.2	68.5	**83.5**
1958	54.4	64.8	75.6	50.2	67.2	68.2	68.5	**83.5**
1959	54.4	71.0	75.6	50.2	81.4	63.3	78.5	**89.3**
1960	54.4	71.0	75.6	50.2	81.4	63.3	78.5	**89.3**
1961	54.4	80.6	84.0	50.2	81.4	**101.0**	78.5	89.3
1962	71.6	80.6	84.0	66.9	81.4	**101.0**	78.5	89.3
1963	71.6	80.6	**121.1**	66.9	81.4	101.0	101.0	89.3
1964	71.6	80.6	**121.1**	66.9	81.4	101.0	101.0	89.3
1965	103.1	80.6	**121.1**	66.9	94.9	101.0	101.0	105.8
1966	127.7	86.2	**133.2**	66.9	112.6	120.5	110.8	105.8
1967	127.7	101.8	**133.2**	66.9	112.6	120.5	110.8	105.8
1968	127.7	101.8	**133.2**	66.9	116.1	120.5	110.8	105.8
1969	127.7	101.8	**133.2**	105.7	116.1	120.5	111.0	132.8

Note: No four-wheel-drive or propane gas models were included. Data are maximum belt or power take-off (PTO) horsepower at rated engine r.p.m. Highest horsepower tractor offered in each year shown in bold face type.

Source: Based on tractors reported on in Nebraska Test Reports.

TABLE 9.8–DIESEL TRACTORS PRICE PER HORSEPOWER, BIG THREE AND OTHER FIRMS COMPARED AND COMPANIES WITH LOWEST PRICED MODELS, BY HORSEPOWER GROUPS, CANADA, 1967 SELLING SEASON

	Horsepower Groups						
	30-45	45-60	60-75	75-90	90-100	100-115	115-135
Companies[1]	$	$	$	$	$	$	$
Big Three	91.21	108.28	115.28	108.78[2]	96.28	98.87[2]	92.30[3]
Allis-Chalmers	130.73	127.27	–	104.72	93.36	–	92.21
British Leyland (Nuffield)	95.88	91.29	–	–	–	–	–
Case	111.10	117.64	112.77	101.03	–	97.74	–
Cockshutt	97.64	123.10	107.12	–	93.25	102.50	–
David Brown	103.36	96.66	–	–	–	–	–
Ford	99.67	106.69	106.08	–	–	–	–
Minneapolis-Moline	–	–	98.11	–	–	87.73	–
Versatile	–	–	–	–	–	–	84.71
Company with Lowest Priced Model							
Lowest	Cockshutt	British Leyland	Minneapolis-Moline	Case	Deere	Minneapolis-Moline	Versatile
Second lowest	Deere	David Brown	Cockshutt	Allis-Chalmers	Cockshutt	Case	Deere
Third lowest	International Harvester	Massey-Ferguson	Ford	International Harvester	Allis-Chalmers	Cockshutt	Massey-Ferguson

[1] In the cases where a company has more than one model in a horsepower group, the price shown is an average of the models.
[2] The Big Three is represented by International Harvester only in these two horsepower groups.
[3] Deere and Massey-Ferguson only.

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, 1969), Tables 5.2, 5.3, 5.4, 5.5, and 5.6.

its version of the Volvo combine. Claas now manufactures a combine to Ford's design for sale in North America. Thus the decline in the market share of the Big Three reflects competition from three combines that were not sold in Canada before the early (or mid-) sixties.

Some, but by no means all, of the changes that have occurred in market shares for combines during recent years reflect the influence of price competition. Versatile sells its combine at a price about 25 per cent below the average price of the Big Three. Cockshutt's price on its two larger models is about 15 per cent below the Big Three's, and Ford offers its larger Claas models at a price 8 to 10 per cent lower. In contrast, both Case and New Holland offer their combines at prices very close to those of the Big Three. Within this latter group, Deere prices its combines on the average about 4 to 5 per cent higher than International Harvester and some 7 to 8 per cent higher than Massey-Ferguson. Yet in recent years Deere's share of the combine market has increased, whereas the share of both Massey and International have declined. White Motor's market share for combines is significantly lower than the share of the predecessor companies it acquired–Oliver, Minneapolis-Moline, and Cockshutt. Some of this may have been due to the disappearance of the Oliver brand name. But the loss of Cockshutt sales through the C.C.I.L. distribution system and their replacement by first the Clayson combine and then Claas must also have had a significant influence. Because combines are such large and complex machines, these price comparisons can be approximate only. Table 9.9 summarizes prices of self-propelled combines for four major size groups in 1967. Prices are for combines with a comparable range of options and group models that are considered competitive by company sales aid literature. However, there is no precise measure of combine capacity available comparable to that provided by horsepower for tractors. Although it has lost some of its former market share, Massey-Ferguson is still the largest single seller, undoubtedly a reflection of the reputation it developed as the first firm to successfully pioneer the self-propelled combine.

Some data on production of combines in the non-Communist world is given in Table 9.10. Estimated total output in 1965 was 123,000, of which about 56 per cent was manufactured by the four largest firms–Claas, Massey-Ferguson, Deere, and International Harvester. An additional 24 per cent of the total is provided by the next four largest firms–Clayson (New Holland), Allis-Chalmers, Bolinder-Munktell (Volvo), and Case. Claas is the largest single manufacturer of combines, with 22,000 in 1965, and manufactures all of these in one plant. Massey-Ferguson's world output is almost as large as that of Claas, but Massey-Ferguson's output is divided among five different plants, with its Brantford plant accounting for about 45 per cent of this total.

Evidence as to economies of scale for combines is less solid than for tractors. However, Commission estimates indicate that production costs per unit decline about 13.5 per cent as output increases from 5,000 to 20,000. The fact that

TABLE 9.9–COMPARISON OF SELF-PROPELLED COMBINE PRICES, CANADA, 1968 SELLING SEASON

	GROUP 1			GROUP 2			GROUP 3			GROUP 4		
	Suggested Retail Price	Percentage of Group Average Price	Percentage of Average 'Big Three' Price	Suggested Retail Price	Percentage of Group Average Price	Percentage of Average 'Big Three' Price	Suggested Retail Price	Percentage of Group Average Price	Percentage of Average 'Big Three' Price	Suggested Retail Price	Percentage of Group Average Price	Percentage of Average 'Big Three' Price
	$			$			$			$		
Allis-Chalmers	9,315	110.7	115.4	–	–	–	11,448	102.6	97.1	13,555	99.1	95.7
J. I. Case	8,503	101.1	105.4	9,710	98.1	99.7	11,610	104.0	98.5	14,022	102.5	99.0
C.C.I.L. (Claas)	–	–	–	–	–	–	10,871	97.4	92.2	13,780	100.7	97.3
Cockshutt	8,446	100.4	104.6	9,982	100.9	102.5	9,953	89.2	84.4	12,034	88.0	85.0
John Deere	8,407	99.9	104.2	10,341[1]	104.5	106.2	12,357[1]	110.7	104.8	14,488	105.9	102.3
Ford Motor Company (Claas)	–	–	–	10,064	101.7	103.3	11,569	103.6	98.2	13,361	97.7	94.4
International Harvester	7,636	90.8	94.6	9,792	99.0	100.6	11,596	103.9	98.4	14,343	104.8	101.3
Massey-Ferguson	8,171	97.1	101.2	9,082	91.8	93.3	11,407	102.2	96.8	13,646	99.7	96.4
New Holland	–	–	–	10,289	104.0	105.7	11,920	106.8	101.1	13,899	101.6	98.2
Versatile	–	–	–	–	–	–	8,900	79.7	75.5	–	–	–
Average (unweighted) price for group	8,413	100.0		9,894	100.0		11,163	100.0		13,681	100.0	
Average (unweighted) price for Big Three (John Deere, International Harvester, Massey-Ferguson)	8,071	95.9	100.0	9,738	98.4	100.0	11,787	105.6	100.0	14,159	103.5	100.0

[1] Prices are for Deere models 55 (Group 2) and 95 (Group 3), made in U.S. plants. Prices for Deere German combines 430 (Group 2) \$10,039 and 630 (Group 3) \$12,209 are almost identical to the similarly equipped combines made in the United States. Chief specification difference is substitution of diesel engine in Europe for gasoline in North America (1969 prices).

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table 5.7.

TABLE 9.10–WORLD PRODUCTION OF COMBINES IN 1965, ACTUAL AND ESTIMATED
(Except U.S.S.R., China, and East European Countries)

(Thousands of units)

Figures in italics are estimates

Company Ranking According to Market Share	World	U.S.A	Federal Republic of Germany	Canada	Belgium	Britain	Sweden	France	Denmark	Japan	Australia	Italy	Austria	Other
Claas	*22.0*		*22.0*											
Massey-Ferguson	21.4		5.4	9.6		3.7		1.1			1.6			
Deere	*15.0*	*13.5*	*1.5*											
International Harvester	*11.0*	*9.5*		*0.5*				*0.5*			*0.5*			
Clayson	*10.0*	*1.0*			*9.0*									
Allis-Chalmers	*9.0*	*8.5*				*0.5*								
Bolinder-Munktell	*4.9*						*4.9*							
Case	*4.8*	*4.8*												
Braud	*3.3*							*3.3*						
Cockshutt	4.0			4.0										
Versatile	*0.5*			*0.5*										
Other	*17.2*	*1.1*	*2.5*			*1.0*	*0.3*		*4.8*	*3.4*	*0.5*	1.6	*1.0*	*1.0*
World Total	*123.1*	38.4	*31.4*	14.6	*9.0*	5.2	5.2	4.9	4.8	*3.4*	*2.6*	1.6	*1.0*	*1.0*

Source: Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), Table 2.7, p. 12.

combine prices in West Germany are significantly lower than in any other western country appears to confirm the view that economies of scale are substantial. The Commission's investigations showed that in 1966 dealer prices for identical combines were from 24 to 28 per cent lower in West Germany than in Canada, or in absolute terms were lower by from $1,800 to $1,950. It is probably not accidental that the lowest-priced market is also the country in which the plant with the largest volume is located. Although the evidence is less firm, it seems probable that—as is true for tractors—existing prices on combines in North America yield a substantial profit (return on manufacturing assets) to the largest-volume producers, and allow the smaller-volume, higher-cost producers to survive. If combine production in the non-Communist world were concentrated into five or six plants, or a somewhat larger number of plants with the different plants of each firm integrated so as to secure the maximum economy in the supply of basic components, combine costs and prices could be significantly reduced.

Other Farm Machines – For swathers, the decline in the Big Three's share from 50.1 to 30.7 per cent between 1957 and 1967 was largely due to the success of Versatile, which first entered the market in 1958 and by 1967 provided about one-half of all the swathers sold in Canada. Versatile's success was based on a swather that sold for 25 per cent or more below the prices of competing brands. Its swather was somewhat lighter in construction, but well suited to the Prairie grain area where Versatile's sales have been concentrated. The decade that ended in 1967 also saw a shift from the use of pull-type to the more expensive self-propelled swathers, a type with which Versatile has had marked success.

The very moderate decline in the Big Three's share of the haying machinery market was almost entirely due to the growth in the share of New Holland and Ford. For plows, which includes the disker, the decline in the Big Three's share from 58.2 to 45.8 per cent reflected mainly the growth in C.C.I.L.'s share. C.C.I.L. was the first firm to market the disker, and its share of the plow market has increased very markedly since the early sixties. In part, this reflects the completion of a depot system which gives C.C.I.L. better market coverage. Within the Big Three, there were diverse trends over the decade. Massey-Ferguson's share of this market increased moderately, whereas the share of Deere and International Harvester declined markedly. The share of White Motor is also down sharply, compared with the position of the three firms it took over.

The rather large decline in the Big Three's share of the market for tillage, cultivating, and weeding equipment, from 55.9 per cent in 1957 to 32.4 per cent in 1967, has been almost entirely due to the growth in the share of C.C.I.L., Morris Rod Weeder, and a number of smaller companies. The share of this latter group grew from about 22 per cent in 1957 to 38 per cent in 1967. The loss was shared by each of the Big Three; all of them registered significant losses in market share.

For seeding, planting, and fertilizing equipment, the Big Three's share increased slightly over the decade. However, their share has declined moderately in the past few years from about 62 per cent in 1963 to 56 per cent in 1967. Here again, the growth of a number of very small firms and the entry of the Morris Rod Weeder into this market has accounted for much of this change. Within the Big Three, one firm increased its share, one lost ground, and the third registered little change.

This analysis suggests that a variety of factors have been important in explaining the decline in market share suffered by the Big Three during the past decade. Price competition has been a significant factor for tractors, combines, and swathers. It may have been important for other products as well; evidence is not available. But the continuous technical change and the shift in demand towards larger sizes of machines have also created opportunities for the smaller firms to exploit. The ability of C.C.I.L. to market successfully tractors and combines produced in Europe, once it had fully developed its distribution system on the Prairies, was also a factor of some significance. Price competition by medium-sized or smaller firms was probably the most important factor. But price competition alone would not explain the extent of the declines that have occurred.

For the industry as a whole, in both Canada and the United States, available data suggest that the share of the major firms has declined very substantially since before the Second World War. In Canada the share of the four largest firms has fallen from an estimated 76 per cent of total sales in 1926-35 to 51 per cent in 1967. In the United States the four largest firms accounted for 72 per cent of manufacturing shipments of farm machinery in 1935. By 1963 their share had fallen to 42 per cent.

These very large changes in market shares are not easy to explain. Both in Canada and the United States the decline reflects in some measure the loss by International Harvester of its former dominant position in the industry. In Canada, in the late twenties, International Harvester enjoyed about one-third of the total market. To some degree also, this decline in the relative position of the dominant firms probably reflects the increasing diversity in the range of machinery produced by the industry. There now are many more specialized machines for particular types of agriculture–machines such as cotton pickers, peanut combines, or tomato harvesters. Often these specialized products are produced entirely by short-line firms or by just one or two of the dominant firms and a number of smaller firms. Even for traditional farm operations such as haying, a much greater range of machines is now available. Formerly, almost every farm had a mower and a hayrake. Now farmers may use one or more of the following machines: mower, hay-baler, hay conditioner, forage harvester, or a variety of different rakes. No major firm can easily maintain a dominant position throughout the full range of machines now offered for sale. Thus the decline in the major firms' share of total farm machinery

sales has probably not been paralleled by an equal decline in their share of major products such as tractors and combines.

New Models and New Inventions as a Competitive Factor

While it is difficult to quantify the effects of the introduction of new machines or the improvement of older machines, there can be little doubt that these changes have very significant effects on the competitive position of different firms. Massey-Ferguson's present lead in world tractor production owes a great deal to the three-point hitch and other pioneering improvements by Harry Ferguson. Similarly, Massey-Harris, after their successful introduction of the self-propelled combine, at one time had captured more than half of the U.S. combine market, even though its U.S. dealer organization was not strong and it had only about 5 per cent of the U.S. tractor market. Farmers complain about the frequency of model changes. But there is also evidence that they respond fairly quickly to improvements. The company that fails to improve its products at frequent intervals may find its market share declining sharply.

Some evidence in support of this view is provided by the marked variations that have occurred in the market share of different companies over the decade ended in 1967. If the market share of different companies for their best and worst year over the decade are compared, the variations shown in Table 9.11 are revealed. It is clear that the changes in market share have been substantial. For any given product line, some firms increased their share over the decade, while others lost ground. Others increased their share only to lose it again, or lost it and then regained it. Changes in market share have often been very large within a few years. While not conclusive, these changes strongly support the view that product improvement is an extremely important competitive factor in the industry.

The significance of customer acceptance of a product is very evident from the marked variations that occur in the market share of any one company for different product lines. If, for the seven major product lines of each company for 1967, we take the difference between the product line where the market share is the highest and where it is the lowest, we obtain the following results in percentage points: Case, 15.6; International Harvester, 21.5; John Deere, 11.8; Massey-Ferguson, 18.6; White Motor, 11.2. Given the fact that the dealer organization is a constant factor for all products, and on the assumption that product pricing will be comparable throughout a company's product range, it is clear that the quality of a product and its customer acceptance is a major element in determining a company's sales in a given product line. For each of the major full-line firms, the market share may be quite high in some lines and comparatively low in others. These considerations undoubtedly underlie the emphasis that the farm machinery companies place on product improvement.

TABLE 9.11–DIFFERENCE IN MARKET SHARE BETWEEN BEST AND WORST YEAR, BY COMPANY AND PRODUCT LINE, CANADA, 1957-67

(Percentage point differences)

	Tractors	Combines	Swathers	Haying Machinery	Plows	Tilling and Cultivating Machinery	Planting and Seeding Machinery
Case	8.2	9.4	14.2	4.1	2.9	4.3	6.3
International Harvester	7.9	6.8	15.5	10.7	7.2	14.1	12.8
John Deere	5.4	8.8	10.3	3.7	7.9	6.4	4.4
Massey-Ferguson	9.4	14.4	8.8	9.8	5.6	4.7	7.0
White Motor	5.2	14.3	32.7	4.6	6.2	4.1	11.2

Source: Company's confidential returns to Dominion Bureau of Statistics, provided to the Commission with the companies' permission, and DBS, *Farm Implement and Equipment Sales*, Cat. No. 63-203, various years. Data for White Motor include combines share of predecessor companies in earlier years.

The importance of market acceptance for a firm's product line may help explain the emphasis that firms place on the introduction of new models. An analysis of the new tractor models introduced by the various farm machinery firms over the period from 1946 to 1967 indicates that during the earlier period–from 1946 to 1956, when there was a substantial backlog of demand and farm machinery sales were relatively buoyant–there was little change in the number of models offered for sale. However, during the past decade, the first half of which was a period of depressed sales, there has been a sharp rise in the introduction of new models. This is evident from the data given in Table 9.12.

Over the period from 1946 to 1956, only Allis-Chalmers and Massey-Ferguson increased the number of models offered for sale, and even then by only one and two, respectively. But over the period from 1956 to 1967 three companies – Allis-Chalmers, Case, and International Harvester–sharply increased the number of models offered. Deere added one model and Massey-Ferguson reduced their range by one. For all companies, there was also a very large increase in the number of tractor model variations made available to farmers.

One index of the industry's view of the importance of technical change is the arrangement that exists among the major firms with respect to patents. In their appearances before the Commission, all of these firms stated that it was normal to license new technical developments for manufacture by other firms. Usually, this would be after a lag of a year or two, which would give the originating firm a small headstart. In the past, new inventions have often led to large shifts among leading firms in market shares. A tacit agreement to license new inventions after a short lag reduces the risk of substantial changes in market shares for particular product lines. Given the inherently risky nature of farm machinery production, the firms have presumably recognized that such an arrangement is in the best interest of the industry as a whole.

TABLE 9.12–BASIC FARM TRACTOR MODELS AND TRACTOR MODEL VARIATIONS AVAILABLE, SELECTED COMPANIES, NORTH AMERICA, 1946, 1956, AND 1967

	Basic Farm Tractor Models			Tractor Model Variations		
	1946	1956	1967	1946	1956	1967
Allis-Chalmers	3	4	8	7	9	76
Case	4	4	7	9	28	79
Oliver	5	5		9		
			8			112
Cockshutt	–	4			18	
Deere	5	5	6	15	31	70
International Harvester	11	10	16	38	27	146
Massey-Ferguson	7	9	8	12	29	52
	35	41	53	90[1]	142[1]	535

[1] Totals incomplete because Cockshutt data for 1946 and Oliver data for 1956 not available.

Source: From D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Tables 6.18 and 6.19.

New inventions are particularly important in the farm machinery industry because they offer the possibility of a reduction in farm production costs. These improvements may be worth a very considerable amount to the farmer, and this makes it almost impossible for other firms to compete by offering their unimproved model at a lower price hence the industry's emphasis on research and development, described elsewhere in this Report. Even with patent licensing, the advantage of being the first firm to offer an improved product may often be substantial.

Price Leadership

In any industry where a small number of firms have a dominant share of the market, each firm, in setting its price, will be very conscious of the prices of its major competitors. In this kind of market situation the practice of price leadership often develops. The leading seller in a particular product line will usually be the first to announce any price changes, and the remaining firms will determine their own prices in the light of the change announced by the dominant firm. Does the practice of price leadership exist in the farm machinery industry? While the evidence is far from conclusive, there is some evidence that one of the major firms is a recognized price leader. For a number of products, Deere & Company, the major firm in the U.S. market, appears to be this price leader.

In examining this question it must be recognized that the entire North American market is regarded as a single unit by most companies for pricing purposes. Even where a company has separate price lists for Canada and the United States, any significant price change is likely to apply to the entire region. In the farm machinery industry it is customary to announce price changes during the slack winter season. Often these price changes will be at the time of the company's fiscal year-end. Often, they will accompany the introduction of new products or model changes. The fiscal year of major companies in this industry ends either on October 31 (John Deere, Massey-Ferguson, J. I. Case, Allis-Chalmers, and International Harvester) or December 31 (White Motor and Ford).

During the hearings, several firms noted that one major firm almost invariably announces price changes at the time of its fiscal year-end because of its contractual relations with its dealers. The firm in question was evidently John Deere. John Deere Limited, the Canadian subsidiary, has an Authorized Agricultural Dealer Agreement which provides that prices of goods sold outright to the dealer "are those in the Company's price book in effect on the date of shipment". However, while the parent company in the United States, Deere & Company, sells its goods outright to its dealers, the Canadian subsidiary normally consigns its machines to dealers. The normal dealer price of consigned goods is "that established by the Company and in effect on the date the consigned goods were delivered to the Dealer". The company, however, guarantees that the dealer's price will be the "price in effect on November 1" of the preceding year (the date upon which the immediately preceding annual contract expired and was, presumably, renewed), if certain conditions are met. For the dealer, the effect of the conditions is that, if he

orders machines up to January 15 of the selling season, he is guaranteed the price in effect at the commencement of the contract period, even if prices have risen in the interim delivery period. Thus for this company there is some pressure to ensure that its prices are issued by a fixed date, namely the beginning of its fiscal year, rather than have the date of its price list fixed entirely by marketing considerations. According to one comment"...this competitor almost without exception establishes prices at that date, whether at that date a new or different product or products with changes in them are being announced or not. Whereas other competitors, and we ourselves often defer or anticipate this date, depending upon the necessity to put into the pipe line or to introduce for various commercial reasons a minor change in the product and the price change that goes with such a minor change."[6]

An examination of the timing of price changes for major product lines in Canada during the period from 1963 to 1968 suggests that John Deere Limited has in the great majority of instances been the first company to announce a price change during a new selling season. For tractors, on all occasions but one it was first. For combines, it was also first, four out of five times. For hay and forage machines, again it was first, four out of five times. And for all other machinery it was first, three out of five times. In every product group where it was not first to announce prices, it was second.

If Deere is the industry's price leader as far as timing of price changes is concerned, how closely are its reported percentage price changes matched by other companies in the industry? In certain years the match is very close. For example, Deere increased its tractor prices for the 1964 selling season by 2.6 per cent; International Harvester and Massey-Ferguson later issued price lists which showed average increases of 2.4 and 2.7 per cent respectively; J. I. Case's increase was 2.4 per cent. For other selling seasons in tractors, the price changes, while not as close, are generally similar (see Table 9.13). Further, if the price changes for tractors over the five-year period from 1963 to 1967 are cumulated, the total price changes for major companies are very similar. Thus, for Deere, it was 14.8 per cent; for International Harvester, 15.6 per cent; for Massey-Ferguson, 13.5 per cent; and for Case, 14.1 per cent. These percentage changes are as measured by each company and reported to the Commission.

For other machines the data are less complete and there is more variation evident in the amounts of price increase. For example, over the period 1963 to 1967, a simple cumulation of annual percentage price changes on combines shows a total increase of 18.9 per cent for Case and 16.7 per cent for John Deere, but only 7.3 per cent for Cockshutt. Some of the difference for Cockshutt may well be due to the fact that it was operating under new management, and because the consolidation of the combine operations of Oliver, Cockshutt, and Minneapolis-Moline undoubtedly resulted in substantial cost savings in this period. Similarly, for all other machinery, the cumulative price increase was 9.8 per cent for Cockshutt,

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[6] Royal Commission on Farm Machinery, Transcript of Evidence, *Hearings*, Vol. No. 37, January 9, 1968, pp. 4196-7.

16.3 per cent for John Deere, and 17.0 per cent for Massey-Ferguson. Thus, while there is considerable evidence to support the view that John Deere is normally the first company to announce price changes, there is a good deal of variation in the extent to which Deere's price changes are followed by other companies.

TABLE 9.13–PRICE CHANGES, TIMING OF AND PERCENTAGE CHANGE, ONE SELLING SEASON OVER PREVIOUS SELLING SEASON, MAJOR COMPANIES AND PRODUCT LINES, CANADA, 1963-68 SELLING SEASONS

(Price change announced first is in italics)

	1963	1964	1965	1966	1967	1968[2]
Tractors						
Case	1.8	2.4	2.2	3.2	4.5	5.0
Cockshutt	2.8	1.8	2.8	2.9	3.7	n.a
Deere	*2.3*	*2.6*	*2.8*	*3.1*	4.0	n.a
International Harvester	2.7	2.4	3.4	4.0	*3.1*	3.8
Massey-Ferguson	2.3	2.7	3.5*	3.0	2.0	4.2
Combines						
Case	3.2	2.6	4.0	*4.5*	4.6	n.a
Cockshutt	0.4	0.9	1.7	1.4	2.9	n.a
Deere	*2.9*	*4.2*	*3.1*	*3.3*	3.2	n.a
International Harvester[1]	2.4	2.4	2.9	3.5	2.7	3.5
Massey-Ferguson	2.0	n.a	7.8	3.5	n.a	5.9
Hay and Forage Machines						
Case	n.a	n.a	n.a	n.a	n.a	n.a
Cockshutt	3.8	1.8	1.8	(5.4)	2.5	n.a
Deere	2.9	*5.2*	*3.4*	*3.4*	*3.1*	n.a
International Harvester[1]	2.4	2.4	2.9	3.5	2.7	3.5
Massey-Ferguson	n.a	n.a	5.0*	1.0	3.0	3.0
All Other Machinery						
Case	n.a	n.a	n.a	n.a	n.a	n.a
Cockshutt	3.5	0.6	2.3	1.4	2.0	n.a
Deere	*2.9*	*4.3*	*2.8*	3.3	3.0	n.a
International Harvester[1]	2.4	2.4	2.9	*3.5*	*2.7*	3.5
Massey-Ferguson[3]	2.8	4.0	4.1	3.1	3.0	3.3

n.a–amount not available.
*Major product change year.
[1] I-H reports showed only "tractors" and "all other farm equipment".
[2] Timing data not available for all companies.
[3] It should be noted that Massey-Ferguson reported a decrease in swather prices of from 12.9 to 18.9 per cent for 1968 selling season which if the category had been indicated on the table would have been given as an average decrease of 15.9 per cent.
Source: Data supplied by companies.

Other instances of price changes which diverged sharply from the pattern of price change set by Deere can be given. For example, Cockshutt reduced its price on haying and forage machinery by 2 per cent for the 1964 selling season and by 5.4 per cent in the 1966 selling season. Deere's prices advanced by an average of 3.6 per cent a year throughout this period. Again in 1965, Ford announced a price

reduction of 17.5 per cent on a new model of their 4000 series tractor. In another instance, Massey-Ferguson announced a price reduction on haying and forage machinery (the price reduction was on swathers only) averaging 13 to 19 per cent for the 1968 selling season (Table 9.13). In each case special circumstances probably account for this change. The Cockshutt price adjustment undoubtedly reflected the new ownership and cost conditions affecting the company. For Ford, the result may have been due to lower costs resulting from the establishment of new production facilities in Basildon and Antwerp. The price reduction by Massey-Ferguson was mainly a price adjustment on swathers and was directly attributable to competition provided by Versatile. None of these price reductions appears to have provoked any immediate response from Deere.

Conclusions

Because fixed costs in the industry are so important, major firms are reluctant to compete actively on a price basis for fear they will invite retaliation from other large firms, thus reducing profits in the industry generally. Smaller firms may attempt to increase their market share by competing on a price basis but for a number of major products—such as tractors and combines—their ability to do so is limited by the absence of economies of scale. A price that yields a very substantial return on manufacturing assets for a major firm may provide a smaller-volume firm with very moderate profits.

Despite the advantage enjoyed by the larger firms from these economies of scale, their share of the market has declined very significantly over the past decade. Even at the start of this period, the market share of the four largest firms was much smaller than it had been in the late twenties and early thirties.

This decline in the market share of the three or four largest firms reflects a number of factors. In part, evidence suggests that the high prices maintained by the dominant firms on tractors and other major products has invited the survival and growth of smaller firms. But the continuous rapid technological change that has characterized the industry's product has also created opportunities for the smaller firms to maintain or improve their position. The decline in the Big Three's share of the Canadian tractor market has been due to their failure to move into and maintain their relative position in the rapidly growing high-horsepower sector of the market. At the same time, the high prices and profit margins in this sector of the market have created opportunities for smaller firms, such as Case and Versatile, to improve their market position. Increased competition from tractors and combines manufactured in Europe has also helped reduce the market share of the major firms. Some of this competition has come from firms such as British Leyland and David Brown who have been selling through their own dealer organizations. Other imports have been marketed by co-operatives such as C.C.I.L. and Coopérative Fédérée de Québec or by long-line firms adding a European model to their product line.

Note to Chapter 9

RECORD OF EVENTS AND PRICE CHANGES SUBSEQUENT TO PUBLICATION OF COMMISSION'S SPECIAL REPORT ON PRICES OF TRACTORS AND COMBINES IN CANADA AND OTHER COUNTRIES

The purpose of this note is to bring up to date (to the current 1970 selling season) the price-comparison data between Canada and Britain, and to review developments since the Commission's *Special Report* was published. The principal conclusions of that report may be summarized as follows:

1. Wholesale or dealer prices of farm tractors for all sizes up to about 75 HP have been very much lower in England and some other European countries than in Canada. For the 1968 selling season the Commission found differences ranging between 30 and 45 per cent—in dollar terms, between \$837 and \$2,287.

2. These lower prices reflect lower European manufacturing costs. The Commission estimated that at the exchange rates that prevailed when the *Special Report* was written, manufacturing costs in England would be about 25 per cent lower than those in North America at the same volume of output.

3. There are substantial economies of scale in tractor manufacturing. The study prepared for the Commission indicated that manufacturing costs per tractor fall about 19 per cent, or by about \$812, as output increases from 20,000 units annually to 90,000 units annually.

4. In the Canadian market, gross profit margins are very much larger on the larger-horsepower tractors than they are on smaller tractors.

5. Differences in distribution costs and the costs of transportation would account for approximately half of the price difference between the two countries, but the rest of the difference must reflect an additional profit earned by the multinational corporation on its sales in Canada.

Since the publication of the *Special Report on Prices*, the Commission obtained 1970 prices from six companies that sell identical tractor models in Canada and Britain. Four of these companies manufacture in Britain. A fifth, Deere, manufactures its lower-horsepower models for the British market in West Germany. The sixth assembles in Detroit from a mixture of British, Canadian, and U.S. components. For five of these companies—David Brown, Deere, International Harvester, Ford, and British Leyland—the price difference between Britain and Canada must be either additional transport and distribution costs, or global company profit. For the sixth, Massey-Ferguson, the picture is more complex because most of the tractors it sells in Canada come from its Detroit plant, whereas those sold in Britain are manufactured at Coventry. A few MF 135s were imported into Canada from Britain in 1970 for sale at lower prices than for the same tractor built in Detroit. Thus, for Massey-Ferguson, part of the price difference between Canada and Britain may be assigned to a third factor -higher production costs in Detroit than in Coventry. This raises the question of why the company would produce tractors in Detroit for the North American market[7] rather than Coventry if it is significantly more expensive to do so. The answer may lie in the combination of a need to manufacture in

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[7] Ford manufactures (assembles) farm tractors in Detroit (largely for the U.S. market) and industrial tractors, but supplies most of the Canadian market from British production.

North America for an increased sales impact, the requirement for larger tractors in North America than in Europe (although this is surely changing), and a shortage of capacity in Coventry. Whatever the reason, it would be hard to justify producing at a high-cost source over a long period of time.

Price comparisons for the 1970 selling season at the "suggested retail price" and the "net wholesale price" to the dealer are given in Table 9.14. In all cases the prices are taken from price lists supplied by the companies, with the net wholesale price (the amount retained by the company) calculated by applying percentages supplied by the companies to represent the combination of their initial dealer discount and their subsequent volume discounts. No change was reported in these levels in either Canada or Britain from the 1966-67 levels used in the *Special Report on Prices.* The suggested retail prices used were either supplied by the companies themselves on the basis of matched specifications for tractors sold in Canada and Britain, or the Commission submitted them to the companies for checking and concurrence.

As in the *Special Report on Prices,* the Commission feels that the most appropriate price on which to base comparisons between countries is the net wholesale price. This price measures the amount received by the company from the dealer. The suggested retail list price may vary from this price—and from the price actually paid by the farmer—by varying amounts in different countries, because it contains varying amounts of over-allowance for the used machine to be traded in.

Table 9.14 presents suggested retail and net wholesale prices for various models of tractors manufactured by the six companies that sell identical tractors in Canada and Britain. Table 9.15 shows, for the same tractors, the British retail and wholesale price levels as percentages of the comparable Canadian prices for the 1966 to 1970 selling seasons. Nine tractors in the 30 to 45 HP range have a current British net wholesale price that averages 78 per cent of the Canadian wholesale price, with seven of the nine tractors in the group falling in the range of 76 to 83 per cent. In Group II—the 45 to 60 HP class—the British average wholesale price is 71 per cent of the Canadian level, with a high of 72 per cent and a low of 71. In Group III—the 60 to 75 HP class—the average net wholesale price in Britain is 68 per cent of the Canadian level. Here the range is wider, with the Massey-Ferguson 178 being priced in Britain at only 57 per cent of the price for its closest Canadian equivalent, the MF 175, and the Deere 3120 priced at 86 per cent of the 3020 Canadian model.

The change in the pattern of net wholesale prices for these various classes over the period from 1966-67 to 1970 can be summarized as follows:

	I	II	III	IV	V	VI and VII
1966-67	82	73	–	–	–	–
1967	82	75	62	–	118	125
1968	70	65	55	–	110	116
1969	74	63	–	–	100	115
1970	78	71	68	71	105	114

These data show that in Groups I to III wholesale prices in Britain fell substantially, relative to those in Canada, following devaluation of sterling in late 1967, but have since moved back towards their 1966 position. This narrowing of the price differential reflects a larger price increase in Britain since 1968 than in Canada. On seven tractor models for three companies, the price increase from 1968 to 1970 averaged 15 per cent in Britain and 7 per cent in Canada. However, current 1970 prices are still lower in Britain, relative to the Canadian price for the identical tractors, than was true in 1966. Thus, for these three groups, on average, current wholesale prices are from 22 to 32 per cent lower in Britain than they are in Canada, or in absolute terms are lower by from $440 to $2,236 per tractor.

TABLE 9.14–SUGGESTED RETAIL AND NET WHOLESALE PRICES OF FARM TRACTORS, CANADA AND BRITAIN, 1970 SELLING SEASON

(Canadian dollars)

	Model No. (Max. PTO HP)	Suggested Retail Price (SRP) / Net Wholesale Price (NWP)	GROUP I 30-45 PTO HP		GROUP II 45-60 PTO HP		GROUP III 60-75 PTO HP		GROUP IV 75-90 PTO HP		GROUP V 90-100 PTO HP		GROUP VI-VII 100-115 and over 115 PTO HP	
			Canada	Britain	Canada	Britain	Canada	Britain	Canada	Britain	Canada	Britain	Canada	Britain
1. North American Based Firms														
Deere	1020	SRP	$4,098	$3,011										
	(38.9)	NWP	2,992	2,469										
	2020	SRP			$5,776	$3,706								
	(54.1)	NWP			4,216	3,039								
	3020	SRP					$8,271							
	(71.3)	NWP					6,038							
	3120	SRP						$6,300						
	(74.7)[1]	NWP						5,166						
	4020	SRP									$10,549	$9,840		
	(95.8)[2]	NWP									7,701	8,069		
	5020	SRP											$14,961	$15,139
	(141.4)[2]	NWP											10,922	12,414
Ford	2000	SRP	$3,605	$2,387										
	(31.2)	NWP	2,632	1,957										
	3000	SRP	$3,887	$2,625										
	(39.2)	NWP	2,838	2,153										
	4000	SRP			$5,358	$3,362								
	(52.7)[2]	NWP			3,911	2,757								
	5000	SRP					$6,544	$3,609						
	(67.2)[2]	NWP					4,777	2,959						

International Harvester	434 (36.0)[3]	SRP	$3,909	$2,772						
		NWP	2,836	2,273						
Massey-Ferguson	135 Std. Cl. (37.8 (Br.-made)	SRP	$3,538	$2,614						
		NWP	2,583	2,143						
	135 Std. Cl. (37.8) (U.S.-made)	SRP	$3,811	$2,614						
		NWP	2,782	2,143						
	165 Std. Cl. (52.4)	SRP			$5,229	$3,339				
		NWP			3,817	2,738				
	175 Std. Cl. (63.3) (178 in Britain)	SRP					$7,043	$3,543		
		NWP					5,141	2,905		
	1080 (81.2)	SRP							$10,337	$6,540
		NWP							7,546	5,363
2. European-Based Firms										
David Brown	780 Selectamatic (42.0)[3]	SRP	$3,740	$2,492						
		NWP	2,730	2,043						
	880 Selectamatic (42.3)	SRP	$4,380	$2,948						
		NWP	3,197	2,417						
	990 Selectamatic (52.1)	SRP			$4,880	$3,073				
		NWP			3,562	2,520				
	1200 Selectamatic (65.2)	SRP					$5,985	$3,628		
		NWP					4,369	2,975		
British Leyland (Nuffield)	344 (45.0)[4]	SRP	$4,795	$3,296						
		NWP	3,500	2,703						
	384 (56.0)[4]	SRP			$5,685	$3,591				
		NWP			4,150	2,945				

[1] Estimated PTO HP rating from 85 HP engine rating.
[2] Change in PTO HP rating since 1966-67.
[3] Manufacturer's PTO HP rating.
[4] New model, manufacturer's PTO HP rating at standard PTO r.p.m.

Source: Company price lists and correspondence with companies.

TABLE 9.15—SUGGESTED RETAIL AND NET WHOLESALE PRICES OF FARM TRACTORS IN BRITAIN AS PERCENTAGE OF CANADIAN PRICES, 1966-70 SELLING SEASONS

	1966		1967		1968		1969		1970	
	SRP	NWP	SRP	NWP	SRP	NWP	SRP	NWP	SRP	NWP
Company and Model No.	Group I: 30-45 PTO HP									
BLMC Nuffield 344	72[1]	81[1]							69	77
Brown 780	72[1]	81[1]							67	75
Brown 880	71	80							67	76
Deere 1020									74	83
Ford 2000	75	85							66	74
Ford 3000	72	81	72	81	60	68			68	76
International Harvester 434			77	86	66	74	66	74	71	80
Massey-Ferguson 135 (U.S.-made)			70	78	59	67			69	77
Massey-Ferguson 135 (Br.-made)									74	83
Average	72	82	73	82	62	70	66	74	69	78
	Group II: 45-60 PTO HP									
BLMC Nuffield 384	66[1]	74[1]							63	71
Brown 990	68	76							63	71
Deere 710			77	87	58	65	57	63		
Deere 2020									64	72
Ford 4000	68[1]	76[1]	67[1]	75[1]	60[1]	67[1]			63	71
Ford 5000	60[1]	65[1]	59[1]	66[1]	53[1]	59[1]				
Massey-Ferguson 165			64	71	59	67			64	72
Average	66	73	67	75	58	65	57	63	63	71
	Group III: 60-75 PTO HP									
Brown 1200									61	68
Deere 3020 (3120 in Britain)									76	86
Ford 5000									55	62
Massey-Ferguson 175 (178 in Britain)			55	62	49	55			50	57
Average			55	62	49	55			61	68
	Group IV: 75-90 PTO HP									
Massey-Ferguson 1080									63	71
	Group V: 90-100 PTO HP									
Deere 4020			105[1]	118[1]	98[1]	110[1]	89[1]	100[1]	93	105
	Groups VI & VII: 100-115 & over 115 PTO HP									
Deere 5020			111[1]	125[1]	103[1]	116[1]	103[1]	115[1]	101	114

[1] Relatives for predecessor model.

Source: Table 9.14.

For the larger-horsepower groups of tractors, British wholesale prices for the Deere 4020 and 5020, both of which are imported into Britain from North America, were 18 and 25 per cent higher than in Canada in 1967. These differences now have narrowed to 5 and 14 per cent, respectively. The one tractor in Group IV, Massey-Ferguson's MF 1080, manufactured in Britain, appeared for the first time in 1970, and sells in Britain at 29 per cent ($2,183) below the net wholesale price charged to a dealer in Canada.

The above price comparisons are based on official price lists. In addition, under various market conditions, companies may offer special discounts from their list prices. Sometimes a whole line of equipment may be affected; sometimes a particular slow-selling model. In these circumstances the dealer receives an extra allowance for every such sale or for every sale over a quota level. This has the effect of reducing the price to him, and in turn the price at which the tractor can be sold to the farmer. Correspondence with the companies indicate that currently these special discounts would decrease the prices listed in Table 9.14 by up to $200 for some models of some companies. Finally, it must be noted that the recent appreciation of the Canadian dollar will have increased the price differences shown in Tables 9.14 and 9.15 by some 3 or 4 per cent.

It is clear that discriminatory pricing in the sale of tractors is still being practised against the Canadian farmer. This now applies to all tractors in size classes of up to 90 HP. Although the price differences are smaller than those in 1968, they are substantially more than can be accounted for by transport charges and additional distribution costs.

Several other developments since the publication of the Commission's *Special Report on Prices* may be more briefly reviewed. It will be recalled that all of the companies had established effective barriers to the export of tractors from Britain by requiring their dealers to sign agreements that they would not sell for export. The Commission has asked the various companies involved to provide information on the current status of these restrictive clauses in their British dealer contracts. Apparently, the clauses remain unchanged for all companies except Ford. Ford stated that the restrictive clause has now been removed completely, and that British dealers can sell their tractors to anyone for resale and export without restriction. However, information received by the Commission (mid-1970) indicates that British-made Ford tractors are hard to purchase from dealers in Britain if they are to be exported. Ford dealers are reported to be on a quota system based on their 1967 sales level. Ford of Britain assured the Commission that there is no such quota system but reported a shortage of tractors from their company's Basildon plant, largely attributable to work interruptions in supplier plants.

The Commission's *Special Report,* in commenting on the companies' uniform failure to pass on to the Canadian farmer any of the benefits that followed the devaluation of sterling in 1967, made the following statement:

> While conspiracy may be too harsh a word, these data suggest at least a tacit agreement on the part of manufacturers supplying tractors to Canada from Britain to maintain the price in Canada in spite of the advantage afforded by devaluation.

The Commission has since been informed that an advisory memorandum issued by an agency of the British government to all exporting organizations at the time sterling was devalued may have been instrumental in inducing this uniform pattern of response. The memorandum suggested that it would be in order for the companies to raise their export prices to the extent consistent with remaining competitive in export markets.

Two of the recommendations in the *Special Report* suggested that the Canadian government explore the possibility of encouraging the sale in Canada of tractors from Czechoslovakia and Japan. Information has since been made available to the Commission indicating that both these avenues are closed. The Japanese trade representatives in Ottawa have

reported that Japanese firms have entered into technical and licensing agreements with major tractor manufacturers on this continent, which would prevent them from manufacturing tractors for sale in either the Canadian or U.S. markets. Similarly, the Commission has recently been informed that a large North American company has been negotiating for the Canadian and U.S. distribution rights for the Zetor tractor.

Only one company, Massey-Ferguson, has commented in public on the Commission's *Special Report on Prices.* Although this commentary raised a number of points, Massey-Ferguson took special exception to the suggestion that it was making "handsome profits" on its sale of tractors in Canada. As originally used, the term referred to the rate of return earned by the company on its manufacturing investment. Unfortunately, the phrase has frequently been cited out of its original context. As has been explained fully elsewhere in this Report, a farm machinery company may earn a large profit on its manufacturing assets, but this rate of return may be greatly diluted in its over-all return because of the large distribution assets carried by firms in the industry. The Commission regrets the fact that the use of the term "handsome profits" out of context may have created a misleading impression as to Massey-Ferguson's over-all profit position. Elsewhere in the *Special Report* the Commission had estimated that Massey-Ferguson earned an extra profit on Canadian sales as compared with British sales of \$38 and \$177 for its MF 135 and MF 165 tractors, respectively. The company reports that it has had operating losses on sales of farm machinery in Canada over the past three years. On a worldwide basis it estimates that it earned a profit (after tax) of 3.1 per cent on sales of tractors sold in Canada in 1966, and 3.2 per cent in 1969. No information is available as to what return this would yield on invested assets. Massey-Ferguson's losses on Canadian sales, and moderate worldwide profits on tractors sold in Canada, in spite of charging much higher prices to Canadian farmers, appear to result, in part at least, from high distribution costs. In its memorandum commenting on the *Special Report* the company estimated that in 1968 its North American selling, and general and administrative expenses were 16.1 per cent of sales. This compares with the 9.1 per cent reported by the four Group I companies for Canada in the same year.

It appears paradoxical that the farm machinery companies should be selling tractors at much higher prices in Canada than in Britain–30 to 45 per cent higher in 1968, and 22 to 32 per cent higher in 1970–and yet reporting a loss on their total farm machinery sales in Canada for 1969. In very considerable measure this simply reflects the higher costs of an expensive distribution system, costs that have been particularly vulnerable to recent large increases in interest rates. Then, too, it may reflect the fact that tractors are one of the few machines currently being sold in Canada where the major companies can still maintain a reasonable profit margin.

Chapter 10

RETAIL AND WHOLESALE DISTRIBUTION

Retail and wholesale distribution costs make up a significant part of the total price of farm machinery. Estimates by the Commission indicate that currently in Canada the farm machinery dealer receives about 13 per cent of the price paid by the farmer for new machines. An additional 14 per cent covers the cost of wholesale distribution. The remainder can be traced to the cost of manufacture, including the manufacturer's profit, the cost of research and development, and various head-office costs, some of which are related to distribution. This breakdown of the total sales value of farm machinery is based on a comparison of the prices of new machines at different transaction levels as shown in Table 10.1. Let us consider retail and wholesale distribution in turn.

TABLE 10.1–PRICE LEVELS IN THE CANADIAN FARM MACHINERY INDUSTRY

	Percentage of Suggested Retail Price
Suggested retail price (SRP)	100
Price paid by farmer, after cash discount or overallowance on trade-in	84
Net wholesale price (NWP) or net selling price to dealer including volume discounts	73
Typical transfer price between manufacturer and selling division	61
Typical North American manufacturing cost level[1]	54

[1]Based on 11-year average of two major farm machinery manufacturers: Deere & Company (51 per cent) and J. I. Case Company (57 per cent).

Source: N. B. MacDonald, W. F. Barnicke, F. W. Judge, K. E. Hansen, *Farm Tractor Production Costs*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969), Figure 1.

Retail Distribution

During the past 25 years there has been a fundamental change in the way in which farm machinery has been handled at the retail level in Canada. Until the early 1940s most machinery was sold through agents. In 1931, for example, the Canadian

Census of Merchandising and Service Establishments[1] reported 475 dealers and 5,078 agents in the farm implement category. Of this total, 4,518 had annual sales of less than $5,000 (for 1930). For the most part these agents had little responsibility beyond selling. In the words of one farm machinery executive, many of them were little more than "bird-dogs" who helped locate sales prospects. There were agents in almost every village. The farm machinery companies undertook, through their branch offices, the major responsibility of stocking new machines for delivery to farmers, stocking and supplying repair parts, and collecting amounts due on past sales. In 1935 the Massey-Harris Company alone had almost 2,300 agents and 15 branch offices.

In the late thirties the industry changed from an agency basis of operation to selling its products through independent franchised dealers. Massey-Harris (now Massey-Ferguson) made the change in 1944, and moved from 1,957 agents in 1944 to 1,350 dealers in 1950. Unlike the agent, the dealer was an independent businessman who purchased new machines and parts from the company and sold them to his farmer customers. In addition, he was responsible for keeping an adequate stock of parts, providing repair and maintenance services, and implementing the company's warranty programs. In effect, he absorbed many of the functions formerly performed by the companies themselves.

This change from an agency to a dealership basis of operation undoubtedly was induced by the unsatisfactory nature of the agency system, as machines became more complex, and as prompt and reliable repair parts service became more critical. An alternative might have been a system of company-operated stores comparable to the depots now maintained by C.C.I.L. In fact, almost all the companies have a few stores, usually in locations where they have been unable to establish a satisfactory dealer. But the companies uniformly report that the independent dealer provides a more satisfactory basis of operation, both in terms of lower costs and better service. The dealer's income is directly dependent on the efficiency with which he operates and the service he provides. Thus he has more incentive than a salaried manager of a company-owned store. Further, the profitability of dealer operations is often critically dependent on the skill with which trade-ins are evaluated and disposed of. With his entire income at stake, the independent dealer is likely to do a better job in this area than a salaried store manager, who may receive a bonus for a good sales record but would not share in losses.

However, the dealership system still retains many of the elements of the old agency system. The companies provide their dealers with many support facilities and supervise their operations very closely. The dealers are given advice on how to plan and construct their premises, what parts to stock, and how to manage their

[1] Dominion Bureau of Statistics Special Machine Runs of Census of Merchandising and Service Establishments, 1961

business. Training courses are offered for their employees. Product information manuals are provided which give data on the capabilities of various machines and instruct dealers on how to display and demonstrate them. Selling aids provide dealers with comparative data on competitive brands of various machines. Formal sales-training courses and seminars are provided. Service manuals are made available. And within a decade after the end of the Second World War most of the companies began to finance new machines in the hands of dealers under floor-planning arrangements. These arrangements were later extended to second-hand machinery. More recently, many of the companies also introduced retail finance plans.

Supervision of the dealers is carried out by blockmen (district managers, territory managers, etc.) who are responsible for from 10 to 15 dealers whom they visit on a regular basis. The blockman inspects the dealers' premises, keeps a record of sales at the retail level, ensures that the company is paid when sales take place, considers the status and performance of the various dealer departments, takes wholesale orders, reviews the follow-up on collections, and counsels dealers on the many phases of their business. Blockmen are also responsible for recruitment of new dealers in their territory and for dealer development—the upgrading of dealers by introducing new methods and programs. They also participate in local field demonstrations, open houses, and local fairs or exhibitions. On an annual basis they work out a sales quota for each dealer and attempt to see that he realizes it. As will be shown later, all this supervision accounts for a substantial part of the machinery companies' branch-house distribution costs.

The farm machinery companies do not require exclusive dealerships, but they discourage dealers from selling competitive products of other manufacturers on the grounds that this will prevent the dealer from giving their products adequate attention.[2] In fact, all companies accept some joint dealerships in which one dealer represents two full-line or long-line companies. This is more likely to occur in areas where the company's product is less popular or the market is too scattered to support an exclusive dealership. No data are available for all Canada on the extent of joint dealerships, but the following table gives a picture of the situation in Saskatchewan in 1967. As these data show, all companies have some joint dealerships. In general, the proportion of joint dealerships declines as the size of the company's sales increases, but this pattern is not completely uniform. Cockshutt, for example, has a smaller proportion of joint dealers than Massey-Ferguson. Deere, the company that has pioneered the trend towards fewer and larger dealerships, has the smallest proportion of any company. Where joint dealerships exist, in very few instances do the major companies have the dependent franchise—defined as the franchise that yields the dealer less than half of total sales of new machines and parts (for the two major franchises). For the five major companies listed in the top

[2] Ford is the only company requiring its dealers to sign a contract under which they agree not to carry competitive lines. The company may waive this requirement on occasion.

TABLE 10.2 EXTENT OF JOINT FRANCHISES IN SASKATCHEWAN, BY COMPANY, 1967

	All Franchises Number	Joint Dealers		Dependent Franchises	
		Number	Percentage of Total	Number	Percentage of Total
Massey-Ferguson	189	38	20.1	–	
International Harvester	163	29	17.8	4	2.5
John Deere	136	14	10.3	2	1.5
Cockshutt	148	26	17.6	5	3.4
Case	134	45	33.6	4	3.0
Minneapolis-Moline	101	74	73.3	25	24.8
Allis-Chalmers	56	31	55.4	21	37.5
Ford	44	19	43.2	11	25.0
Versatile	154	113	73.4	103	66.9
New Holland	98	69	70.4	54	55.1
Total	1,223	458	37.4	229	18.7

Source: P. Woroby, *Location and Performance of Farm Implement Dealers in Saskatchewan*, unpublished Commission study, 1969, based on records of Saskatchewan Agricultural Machinery Administration.

half of Table 10.2, dependent franchises constitute 3.5 per cent or less of the total. In contrast, two-thirds of Versatile's and 55 per cent of New Holland's franchises are dependent.

In the early postwar period, following the change from the agency to dealership basis of operation, the total number of dealers franchised by the major companies remained stable or even increased moderately for some companies. However, following the sharp drop in sales in 1954 a substantial reduction in dealer numbers took place. This decline has been especially marked in recent years and is apparently still continuing. As Table 10.3 shows, dealers franchised by the four major companies in Group I–Deere, Harvester, Massey-Ferguson, and White Motor–declined by about 16 per cent between 1962 and 1966, and have fallen by over one-third since then, bringing the total reduction since 1962 to 45 per cent. For the six companies in Group II– Case, Allis-Chalmers, Ford, New Holland, New Idea, and David Brown -the reduction has been less striking but still substantial, about 25 per cent since 1962. Because of the existence of joint dealerships, the total decline in the number would be less than this.

At one time, competition in the farm machinery industry took the form of blanketing the country with agents or dealerships. In an anti-trust suit in 1912 in the United States, International Harvester was accused of pursuing such a policy and keeping its competitors out of the market by requiring exclusive dealerships and practising full-line forcing. Recently, the emphasis has shifted from dealer numbers to dealer quality. Higher-quality dealers are usually those with large well-equipped facilities in larger centres. The change to this pattern takes place slowly because many existing dealers, although too small by present standards, have a clientele of long-standing customers who might be lost if their dealership was

TABLE 10.3–NUMBER OF FARM MACHINERY DEALER FRANCHISES,[1] GROUP I AND II COMPANIES, CANADA 1950, 1955, 1962-69

	1950	1955	1962	1963	1964	1965	1966	1967	1968	1969
Group I	3,112[2]	2,963[2]	2,934[3]	2,880[3]	2,768[3]	2,615	2,453	2,139	1,849	1,609
Group II	1,108[4]	1,635[5]	1,901	1,885	1,849	1,673	1,652	1,602	1,532	1,434
Total (I and II)	4,220	4,598	4,835	4,765	4,617	4,288	4,105	3,741	3,381	3,043

Note: Group I includes John Deere, International Harvester, Massey-Ferguson and White Motor. Group II includes Allis-Chalmers, Avco (New Idea), J. I. Case, David Brown, Ford and New Holland.

[1]Count includes, where applicable, dealer establishments franchised by more than one farm machinery company.

[2]White Motor Corporation not included.

[3]Totals for Massey-Ferguson for years 1961 (not shown) to 1964 were determined by distributing the difference evenly between the years 1960 and 1965.

[4]Allis-Chalmers, Avco, David Brown and New Holland not included as no dealers listed.

[5]New Holland not included.

Source: Based on data supplied by the farm machinery companies in reply to the Royal Commission Questionnaire #2, re: Distribution Policies and Operations, and on correspondence with the companies.

closed out. In addition, it takes time to find individuals who have both the ability and financial resources needed to manage and develop a large dealership. The fact that the trend to larger dealerships has accelerated recently during a period of buoyant farm machinery sales may be due to the fact that the dealers in question have found it easier to finance the required expansion in this period.

It is clear that this pattern of retail distribution of farm machinery has been planned and organized by the farm machinery companies and reflects their response to competitive forces and the general requirements of the market as they interpret them. The decline in the number of dealers reflects the companies' assessment that the current market can be better served by a smaller number of larger dealers. What have been the economic developments that have produced these changes?

In part, these changes have been induced by changes in the farm machines themselves. Farm machinery has become more complex, sophisticated, and difficult to service. The widespread adoption of diesel engines on tractors with their complex fuel-injection systems, the increasing use of sophisticated hydraulics and sensing mechanisms, and the introduction of more-advanced types of transmissions, have increased the skill required from servicemen and the capital investment needed in service facilities. The sheer growth in the number of different types and models of machines has made the stocking of parts more difficult. All of these changes have favoured the growth of the larger dealer who can afford the investment in service facilities and parts-supply needed to adequately service the newer machines. The minimal service provided under the agency system would be completely intolerable in today's world.

Changes in the size of farm and in farming methods discussed elsewhere in this Report have reinforced this trend. The larger farmers who account for an increasing share of agricultural output are more likely to require the services provided by larger dealers. Such farmers often have larger and more sophisticated equipment which needs specialized attention. Further, modern farming methods that involve larger inputs, such as fertilizers, herbicides, and pesticides, have made the timing of farming operations more critical and have made delays caused by mistakes in ordering parts, or slow service, more costly to the farmer. To the degree that the larger dealer can provide better service—and a Commission survey indicates that mistakes by small dealers accounted for a disproportionate number of farmer complaints of poor service—these changes also have supported the shift to larger dealers.

Improvements in transportation and communication have also supported the growth of the larger dealers and the disappearance of many smaller dealers. The postwar period witnessed a great increase in the mileage of all-weather roads, particularly on the Prairies where the bulk of the Canadian farm machinery market is concentrated. With more and better roads, and more cars and trucks on farms, the farmer now does an increasing share of his shopping for all goods in larger population centres. This has favoured the growth of farm machinery dealerships in these centres relative to those in the smaller villages or hamlets.

These conclusions are supported by an analysis of changes in farm machinery dealerships (excluding short-line dealers) in the Province of Saskatchewan. The number of dealers for full- or long-line companies declined about 37 per cent between 1954 and 1967 and all but 14 per cent of this decline was due to the disappearance of dealers formerly located in villages, hamlets, or sidings. The data are as follows:

Reduction in Full-line or Long-line Farm Machinery
Dealers, Saskatchewan, 1954–67

	1954	1967	Net Change
Towns and greater towns	549	461	–88
Smaller centres	1,146	608	–538
Total	1,695	1,069	–626

Moreover, this decline took place over a period in which total sales of farm machinery and parts increased by about 3.5 times. As a result, average sales of new machines at wholesale prices in 1967 were $132,000 per dealer, compared with $23,800 in 1954. The number of Saskatchewan dealers in 1967, expressed as a percentage of the number in existence in 1954, was as follows:

Location	Percentage	Location	Percentage
Greater Towns	92	Hamlets	45
Towns	64	Sidings	32
Villages	60	Province	63

The larger size of farm machines that has accompanied, and to a major degree caused the shift to larger farms has also given the farmer more incentive to shop for his new machines. At the same time the increased speed with which field operations can be performed has given him more time to do this shopping, and improvements in transportation have made it easier to travel to more distant points. It seems probable that this change also has favoured the growth of the large-volume dealer who, because of his larger volume, can sell individual machines at a lower mark-up over cost. This increased shopping for new machines must also have made the retail market more competitive, for not only would dealers for different companies in one town be in competition with one another, but dealers for the same company in different towns would be competing for some of the same business.

On the other hand, in the sale of repair parts and in the provision of service, it is less clear that the large centres will be favoured. However, even here, the larger dealer has some advantages. Many farmers have said they do not mind driving farther for repair parts if they can be provided with more assurance that they will get them when they arrive. A larger dealer who can afford a larger inventory of repair parts will find it easier to provide this assurance. During the public hearings a number of farmers on the Prairies indicated a willingness to drive up to 50 miles for repair parts. In the analysis of Saskatchewan dealerships referred to above, centres classified as towns were those situated from 20 to 35 miles apart. Greater towns

were over 35 miles apart. Villages were from 12 to 20 miles apart, hamlets from 7 to 12 miles distant, and sidings less than 7 miles apart. Thus the towns and greater towns come within the distance farmers expressed themselves as being willing to drive, and the increasing importance of dealerships in these centres confirms the views expressed.

For service, the increased size and cumbersomeness of machines, particularly combines, would appear to favour patronage of the repair and maintenance service provided by a nearby centre. However, this may well be offset by the increased complexity of machines, which makes them more difficult to service, and by the ability of the larger dealer to move machinery long distances on large low-bed trailers, and to support more expensive service facilities. In addition, some large dealers have established satellite service centres.

The trend towards fewer and larger dealers suggests that there are economies of scale in farm machinery retailing, with costs of operation falling as volume increases. What evidence is there to support this conclusion aside from the evident fact that small dealerships are declining in number and importance? Some data on costs by size of dealership support this conclusion. However, the data are not easy to interpret because of variations in the kind of service performed by different dealers, and the dispersed character of the market they serve. A dealer performs a variety of different functions. He sells a wide variety of new machines, ranging from large tractors and combines manufactured by full-line companies to the grain augers and sprayers produced by short-line firms. He sells parts and attachments. He may also sell a variety of related products such as trucks, industrial equipment, lawn and garden equipment, and snowmobiles. In addition, he provides repair services on existing machines.

The dispersed character of the market may also affect the size composition of firms that can operate efficiently. In a rich agricultural area the average size of dealer may be comparatively large. In more remote and poorer areas, dealerships may be much smaller. This is evident from provincial data. For the three largest farm machinery firms, in 1966 average sales per dealer were $78,000 in the Atlantic Provinces, $83,000 in Quebec, $113,000 in Ontario, and $133,000 in Saskatchewan. Similar variations may well occur within different parts of each province. The reason for this variation is quite clear. Given the limited distance farmers are prepared to travel to a dealer, many of the lower-income farming areas cannot support dealers for each major franchise of more than a moderate size. In a rich area, the economies of scale realized by a larger dealer can have freer play.

An annual survey of dealer operating expenses conducted by the National Farm and Power Equipment Dealers Association, and covering the experience of some 1,400 dealers in the United States and about 45 in Saskatchewan, provides data that are at least consistent with the view that economies of scale exist for farm machinery retailing. The results of the 1967 survey are summarized in Table 10.4.

For the three size groups for which data are presented, the gross operating profit, and accounted operating expenses as a percentage of sales, decline as the sales of dealers increase. The salary and wage data in this survey include an allowance for the proprietor's own labour. However, it does not include as a cost a return on the inventory of new and second-hand machines, which are typically financed on an interest-free basis by the farm machinery companies under floor-planning arrangements.

The omission of this cost would affect the estimate of costs, by size of dealer, since inventory turnover rates for the largest sales group (over $500,000 annually) have been 50 per cent higher than for the smallest group (under $250,000 annually) in each of the last ten years. While these interest costs are absorbed by the company rather than the dealer, the company may take account of them in its dealer policy. Further, for the smallest size group of dealers a larger share of total sales receipts comes from repair parts or service labour, and operating expenses in this business area would be higher.

However, after rough adjustments were made for these last two factors, operating expenses as a percentage of sales for the largest size group of dealers—those with sales over $500,000—were about 6 per cent lower than those in the under-$250,000 size category. If cost differences are this large, one would doubt the ability of the smaller dealers to survive. However, the smaller dealers may often operate in geographic areas where a larger dealer could not obtain the required volume, given the emphasis that companies place on exclusive dealerships and the fact that the dealer services provided under different franchises are not perfect substitutes. In addition, the small local dealer may be able to charge more since he saves the farmer the cost of going a longer distance. Dealers in smaller centres may also survive by accepting lower incomes. Data for Canada obtained from the 1961 Census of Retail Trade show significant economies of scale for dealers with annual sales up to $200,000, but no substantial economies beyond that point. Since the original data did not include any allowance for the proprietor's income, an arbitrary addition of $4,000 was made for each proprietor reported in each size class.[3] An allowance was also made for the cost of floor-planned inventory, since inventory turnover rates increase as the size of dealer increases, up through the $1 million level. The relevant data are given in Table 10.5.

As this table shows, operating expenses (adjusted for proprietor's salaries), as a percentage of sales, decline steadily up to the $200,000 sales level. Thereafter, they level off, although the expense ratio in the $200,000 to $500,000 sales category at 13.9 per cent is substantially lower than in the $100,000 to $200,000 category, 15.6 per cent. This suggests that the most efficient size of firm may be somewhere in the sales range of $300,000 to $500,000. Operating expenses as a percentage of sales, after adjustment for both the proprietor's wage and the cost of

[3]Since wages increase with size of establishment, this constant addition will tend to exaggerate economies of scale. However, the proportion of incorporated firms also increases with size, and in these firms the owner's earnings are already included.

TABLE 10.4–STATISTICS ON DEALERS, CLASSIFIED BY SALES-SIZE, 1967

	All Dealers		Dealers Under $250,000		Dealers $250,000-$500,000		Dealers Over $500,000	
	Dollar Values	Percentage of Total Sales	Dollar Values	Percentage of Total Sales	Dollar Values	Percentage of Total Sales	Dollar Values	Percentage of Total Sales
	($'000)		($'000)		($'000)		($'000)	
I Summary of Financial Statements								
Average sales per dealer	604.4	100.0	165.6	100.0	379.6	100.0	889.0	100.0
Cost of goods sold[1]	529.6	87.6	141.3	85.3	331.2	87.2	781.2	87.9
Gross profit[2]	74.8	12.4	24.3	14.7	48.4	12.8	107.8	12.1
Total accounted expenses	73.9	12.2	22.8	13.8	46.9	12.4	107.5	12.1
Net profit on business	0.9	0.2	1.5	0.9	1.5	0.4	0.3	0.0[8]
Other income	19.1	3.1	4.7	2.8	12.3	3.2	28.0	3.2[9]
Net profit before tax	20.0	3.3	6.2	3.7	13.8	3.6	28.3	3.2
Imputed inventory interest[3]	12.6	2.1	5.0	3.0	9.7	2.5	16.7	1.9
Net profit after adjustment for imputed inventory expense	7.4	1.2	1.2	0.7	4.1	1.1	11.6	1.3
II Operating and Financial Statistics								
Sales analysis (total sales = 100)								
New equipment	57.5%		54.9%		58.6%		57.4%	
Used equipment	16.8%		14.1%		15.9%		17.2%	
Repair parts	15.7%		20.2%		16.4%		15.2%	
Service labour	5.1%		5.6%		4.8%		5.2%	
All other lines	4.9%		5.2%		4.4%		5.0%	
Average number of employees	10.4		4.0		7.5		13.9	
Sales per employee ($'000)	$58.1		$41.4		$50.6		$64.0	

Gross profits (percentages of sales by type of goods)				
New equipment	11.1%	11.7%	11.7%	10.9%
New and used equipment	8.4%	10.8%	9.6%	7.9%
Repair parts	25.6%	25.7%	24.8%	25.8%
Expenses (selected)				
Interest and bank charges ($'000)	$ 2.4	$ 1.0	$ 1.7	$ 3.4
Wages and salaries ($'000)[4]	$56.1	$16.1	$35.8	$81.9
Average wage per employee ($'000)	$ 5.4	$ 4.0	$ 4.8	$ 5.9
Total inventories ($'000)	$199.5	$79.8	$152.1	$267.9
Inventory turnover rate	2.7	1.8	2.2	2.9
Total assets ($'000)	$297.9	$121.6	$217.6	$405.5
Return on assets[5]	7.5%	6.0%	7.1%	7.8%
Return on assets after adjustment for interest charges and imputed inventory expenses[6]	2.5%	1.1%	1.9%	2.8%
Net worth (investment) ($'000)	$107.7	$47.5	$78.7	$145.5
Return on investment[7]	18.6%	13.1%	17.5%	19.5%

[1] Derived from total sales less gross margin.

[2] Excludes volume bonus. Volume bonus, in part, would be included in "Other income".

[3] The imputed inventory cost figure was computed on the basis of 7.5 per cent of the value of inventory less actual interest expense, assumed conservatively to be entirely cost of dealer's own inventory (e.g. parts). In practice, of course, this must include other items.

[4] Including wages of service labour, derived by deducting gross margin for service labour from sales of service labour. (3.8 percentage points of the 9.3 per cent (equalling $56,100) is therefore not included in total accounted expenses in the "total" column.)

[5] Return on assets defined as net operating profit before tax plus interest expense as a percentage of total assets.

[6] Return on assets defined as net operating profit before taxes plus interest expense less imputed inventory costs as a percentage of total assets.

[7] Return on investment is as reported in *Cost of Doing Business Study*. The estimate reflects the financial statements of dealers only and therefore neglects the cost of financing inventory.

[8] Actually 0.03 per cent.

[9] Actually 3.14 per cent.

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 8.1 (taken from National Farm & Power Equipment Dealers Association, *Cost of Doing Business Study for 1967* (St. Louis, Mo.), 1967).

TABLE 10.5–SIGNIFICANT FARM MACHINERY DEALERSHIP STATISTICS AND RATIOS BY SIZE OF DEALERSHIP IN SALES DOLLARS
(Taken from replies to Dominion Bureau of Statistics 1961 Census of Merchandising)

		Size of Dealership in Thousands of Dollars of Sales								
	Total	Under 10	10-20	20-30	30-50	50-100	100-200	200-500	500-1,000	Over 1,000
Percentage distribution of dealers	100.0%	4.8	5.1	5.6	15.3	27.6	22.7	16.4	2.2	0.3
Sales as a percentage of total sales	100.0%	0.2	0.5	1.1	4.6	15.7	24.9	36.8	10.7	5.5
Value of sales per dealership ($'000)	$128.8	5.0	14.8	24.8	38.9	73.1	140.9	288.7	640.0	2,432.6
Value of sales per employee ($'000)	$ 38.3	4.0	9.9	15.5	23.6	30.6	37.6	46.2	50.7	89.2
Gross margin per dealership ($'000)	$ 22.0	1.6	3.7	5.3	8.1	13.1	24.6	46.1	101.8	434.4
Profit before tax per dealership ($'000)	$ 5.1	0.1	1.0	1.9	2.7	3.4	6.5	8.8	15.0	127.4
Profit (adjusted)[1] per dealership ($'000)	$ 1.4	–3.9	–3.2	–2.2	–1.6	–0.6	2.7	6.2	13.9	125.9
Number of employees per dealership	3.4	1.2	1.5	1.6	1.6	2.4	3.7	6.3	12.1	27.3
Cost of sales as percentage of sales	77.8%	51.5	56.0	66.9	74.3	77.5	77.6	79.7	77.8	74.3
Gross margin as percentage of sales	17.1%	31.5	25.0	21.4	20.9	17.9	17.5	16.0	15.9	17.8
Operating expenses as percentage of sales	13.1%	28.7	18.1	13.6	14.0	13.2	12.9	13.0	13.6	12.6
Operating expenses as percentage of sales (adjusted to include proprietors' salaries)	15.0%	110.4	46.8	30.1	25.1	18.7	15.6	13.9	13.8	12.6
Profit before tax as percentage of sales	4.0%	2.8	6.9	7.8	6.9	4.7	4.6	3.0	2.3	5.2
Profit before tax (adjusted to include proprietors' salaries) as percentages of sales	1.1%	–78.9	–21.8	–8.7	–4.2	–0.8	1.9	2.1	2.1	5.2
Inventory turnover rate	3.5	1.3	1.5	2.4	2.8	3.2	3.5	3.6	4.4	6.1
Inventory costs (7.5% of inventory) as percentage of sales	1.6%	2.9	2.8	2.1	2.0	1.8	1.7	1.7	1.3	0.9
Operating expenses (adjusted for proprietors' salaries and inventory costs) as percentage of sales	17.7%	113.4	49.5	32.2	27.1	20.5	17.2	15.5	15.1	13.5

[1] Adjusted for proprietors' salaries.

Source: Taken from D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 8.3 and Commission estimates.

floor-planning, continue to decline slowly throughout the sales range shown in Table 10.5. Since only seven firms in the sales category of $1 million and over provided detailed financial statements, not much confidence can be placed in the estimate for this sales level. Dealers with annual sales of less than $100,000 accounted for only 16 per cent of total sales in 1961, and it seems likely that many of these dealers will have disappeared in the past few years. Some of the higher operating-expense ratios shown by smaller dealers may reflect a larger proportion of sales in the parts and service category. However, no information on the proportion of sales by category is available. The above data are at least consistent with the hypothesis that the most efficient size of dealer is comparatively large, with annual sales of $300,000 or more.

TABLE 10.6–SALES PER EMPLOYEE, BY SIZE OF DEALERSHIP AND GEOGRAPHIC AREA, FARM MACHINERY, CANADA, 1961

(Thousands of dollars)

Size of Dealer by Volume of Sales	Canada	Maritimes	Quebec	Ontario	Prairies	British Columbia
All dealers	38.3	31.3	34.3	33.7	41.9	38.9
Under 10	4.0	5.6	2.9	3.6	4.5	5.1
10-20	9.9	11.6	10.5	9.4	9.9	8.6
20-30	15.5	16.3	15.2	14.8	16.2	–
30-50	23.6	22.9	25.9	22.3	23.6	22.3
50-100	30.6	27.9	29.6	29.0	32.2	30.8
100-200	37.6	31.5	37.3	33.3	40.9	39.9
200-500	46.2	36.0	45.4	41.6	49.6	36.6
500-1,000	50.7	57.4	54.0	44.2	59.8	39.7
1,000 and over	89.2	–	–	59.2	131.9	58.6

Note: Sales per employee were obtained by dividing dollar sales by the number of employees and proprietors.

Source: Dominion Bureau of Statistics Special Machine Runs of Census of Merchandising and Service Establishments, 1961.

Data on sales per employee also increase fairly consistently with the size of dealership, thus providing some additional evidence of economies of scale. As Table 10.6 shows, there are some irregularities in this pattern on a regional basis, but in all areas sales per employee reach their peak when total sales are $500,000 or over.

In 1961, 58 per cent of all farm machinery dealers in Canada had annual sales below $100,000, yet these dealers accounted for only 22 per cent of total sales. About 31 per cent of all dealers had sales below $50,000 annually. How have these small dealers survived? Smaller dealers have fewer employees and may often pay lower wages. Some of the dealers in the lower sales category may have commenced operating during the year. Smaller dealers also have a larger gross margin, suggesting that more of their sales were concentrated in the parts or service category.

Views expressed during the Commission hearings are at least consistent with these conclusions. Cockshutt suggested that the minimum size required for an efficient dealer operation on the Prairies would be the annual purchase from the company of $100,000 in wholegoods and parts at wholesale prices.[4] Ford suggested that the minimum size required for a viable dealership was $150,000 in retail sales, which would probably involve the sale of 15 tractors each year.[5] C.C.I.L. stated that $150,000 retail would be economic, but that costs would continue to decline up to the $250,000 level measured in terms of annual sales of new equipment.[6] International Harvester suggested as a minimum, purchases at wholesale prices of from $50,000 to $60,000 annually.[7] Similarly, Massey-Ferguson suggested the minimum needed for a viable dealer at $80,000 to $100,000 in wholegoods sales (presumably at wholesale prices).[8] When allowance is made for sales of service parts and repair services along with sales of used machines and short-line products, total retail sales might be twice the level measured in terms of wholegoods and parts at wholesale prices. Thus the minimum of $100,000 purchases at wholesale would mean $170,000 or $200,000 at retail.

A number of companies also provided the Commission with data on the number of dealers required to provide 50, 70, and 100 per cent of their sales: For five major full-line companies an analysis of these data gives the following results:

	Percentage of All Dealers	Purchases of Wholegoods and Parts	Estimated Total Sales at Retail
		(Average annual amount per dealer)	
All dealers	100	$107,000	$180,000 to $200,000
Largest dealers accounting for 50 per cent of sales	22	$240,000	$410,000 to $480,000
Next largest dealers accounting for next 20 per cent of sales	16	$136,000	$230,000 to $270,000
Smallest dealers accounting for remaining 30 per cent of sales	62	$ 52,000	$ 90,000 to $100,000

[4] Royal Commission on Farm Machinery, Transcript of Evidence, *Hearings*, Vol. No. 28, November 13, 1967, p. 2888.

[5] *Ibid.*, Vol. No. 31, November 16, 1967, p. 3351.

[6] *Ibid.*, Vol. No. 34, December 13, 1967, p. 3750.

[7] *Ibid.*, Vol. No. 32, December 11, 1967, p. 3443.

[8] *Ibid.*, Vol. No. 37, January 9, 1968, p. 4104.

These data take no account of the existence of joint dealerships. Thus some of the smaller dealers might also hold franchises from other full-line or long-line companies, and this would raise their average sales level.

Analysis of the trend in dealer operating costs over the postwar period suggests that substantial economies have been realized as a result of the move to fewer and larger dealers. Historical data for Canada are not available. However, data for dealers in the United States and Saskatchewan indicate that the gross profit earned by dealers declined from around 25 per cent in the early postwar years to around 15 or 16 per cent in the years 1965 to 1967 (see Table 10.7). If the new and used equipment business is treated as a combined operation (with used machines on a break-even basis) then the profit on new and used machines, as a percentage of new equipment sales alone, shows a roughly comparable decline, from 15 to 17 per cent in the years 1949 to 1951 to about 8 per cent for the years 1965 to 1967. These last data do not include the volume bonus which would add around 3 per cent to both these figures.

While complete information on dealer trade discounts granted by the companies is not available, information from several companies indicates that these discounts have increased moderately over the postwar period. Deere gave a dealer trade discount on new machines of 16 per cent from 1948 to 1955, 20 per cent from 1956 to 1963, and 23 per cent from 1964 to 1968. Massey-Ferguson's discount was 15 per cent in 1950-51, 16 per cent in 1952, 17.5 per cent from 1953 to 1957, and 23 per cent from 1958 onward. International Harvester maintained a discount of 20 per cent from 1948 to 1959 and increased this to 22 per cent in 1960. J. I. Case had an average discount of about 19 per cent from 1948 to 1958, and has since increased it to 23 per cent. As noted, volume bonuses would be additional.

Despite the allowance of higher discounts, operating margins have been declining. This decline in margins reflects a decline in operating expenses as a percentage of sales from about 15 or 16 per cent in the earlier postwar years to just over 12 per cent in 1967 (see Table 10.7). Some of this decline in expenses reflects an increase in the ratio of sales of new and used equipment to total sales. Expenses on the sale of repair parts and for repair services are higher than on sales of new machines. However, the decline in expenses would be significant even without this change. The ratio of net profits before taxes to total sales has remained relatively constant at from 3 to 3.5 per cent of sales over the past decade. The return on investment earned by dealers has increased very appreciably, while the return on total assets has shown only a comparatively small increase. Inventory turnover was exceptionally high in the immediate postwar years when, because of the severe shortage, machinery moved almost directly from the dealer's lot to the farmstead. Since 1954 there has been a moderate decline in inventory turnover.

It seems likely that these apparently conflicting trends are a direct reflection of the introduction of floor-planning on an interest-free basis by the machinery companies in the mid-fifties. This free floor-planned inventory appears as part of

TABLE 10.7–PROFIT AND RELATED DATA FOR FARM MACHINERY DEALERS, 1947-67

	Gross Profit									
	Including Other Income[1]	Excluding Other Income[1]	Operating Expenses	Profit Before Tax	Sales of New and Used Machines	Profit on New and Used Equipment	Inventory Turnover: New Machines[2]	Return on Total Assets[5]	Return on Investment	Average Number of Employees
	(As percentage of total sales)					(As percentage of new and used sales)				
1947	24.7	21.9	15.3	9.4	61.4	20.0	6.6[3]	n.a.	n.a.	n.a.
1948	23.9	21.3	16.1	7.8	55.7	20.0	n.a.	n.a.	n.a.	n.a.
1949	22.9	19.1	17.4	5.5	58.5	17.1	4.0[3]	n.a.	n.a.	n.a.
1950	20.9	18.0	15.9	5.0	63.2	16.2	4.7[4]	n.a.	n.a.	n.a.
1951	19.7	17.0	15.1	4.6	61.8	15.0	3.6[4]	n.a.	n.a.	n.a.
1952	20.2	17.1	16.3	3.9	62.0	13.8	3.2	n.a.	n.a.	n.a.
1953	17.9	14.9	15.4	2.5	58.9	11.7	2.7	n.a.	n.a.	n.a.
1954	18.3	14.8	15.7	2.6	61.3	11.4	3.0	5.8	7.4	n.a.
1955	18.2	15.3	14.8	3.4	61.1	12.0	2.8	8.1	10.6	n.a.
1956	19.0	15.9	15.8	3.2	59.4	12.0	3.1	9.1	11.9	n.a.
1957	18.6	15.9	15.2	3.4	60.6	12.7	2.5	7.8	11.0	n.a.
1958	17.6	14.8	14.2	3.4	64.8	11.0	2.7	7.9	13.2	n.a.
1959	17.5	14.7	14.2	3.3	65.3	10.9	2.3	7.3	13.3	n.a.
1960	17.9	15.1	15.1	2.8	63.9	10.2	2.5	6.5	10.6	n.a.
1961	17.7	14.7	14.6	3.1	66.2	10.2	2.5	6.7	11.2	8.0
1962	17.2	14.3	13.9	3.3	67.4	9.3	3.0	7.9	14.5	9.0
1963	17.0	14.0	13.7	3.3	70.7	9.5	3.2	8.0	15.0	9.3
1964	16.6	13.6	13.3	3.3	69.2	8.9	3.0	8.1	15.8	10.8
1965	15.9	13.0	12.7	3.2	71.2	8.2	3.3	8.1	16.4	10.9
1966	15.7	12.8	12.2	3.5	73.9	8.6	2.7	8.4	19.5	10.5
1967	15.5	12.4	12.2	3.3	74.3	8.4	2.4	7.5	18.6	10.4

[1] Part of other income is made up of volume bonus.
[2] Calculated as ratio of cost of goods sold for new machines only divided by year-end inventories of new machines.
[3] Rate taken directly from *Cost of Doing Business Study* and includes both new and used equipment.
[4] Rate taken directly from *Cost of Doing Business Study*. For other years, 1952-67, rate was calculated by Commission staff.
[5] Return on total assets defined as net operating profit before tax plus interest expense as a percentage of total assets.
Source: National Farm & Power Equipment Dealers Association, *Cost of Doing Business Study* (St. Louis, Mo.), annual publication, 1947-67.

the dealer's total assets but is provided on an interest-free basis. The introduction of free floor-planning undoubtedly induced the dealer to carry a larger inventory, but without adding significantly to his total costs. For this reason a comparatively constant return on total assets including floor-planned inventory could yield a larger return to owners' equity.

Some historical data suggest that dealer profits measured as a return on equity have declined, compared with their level in 1929 or 1935 and 1936. Gross margins also appear to be lower now than they were in the prewar period. The Federal Trade Commission estimated the average gross margin in the United States in 1936 at about 23 per cent, appreciably higher than the 15.5 per cent recorded by dealers in 1967. This reduction in profits and operating margins undoubtedly reflects efficiencies resulting from the move to larger and more efficient dealers, and has been fostered by increased dealer competition.

Wholesale Distribution

A major part of the wholesale distribution of farm machinery in Canada is performed by the full-line and long-line companies themselves, through their branch office distribution system. These firms along with C.C.I.L. account for over 80 per cent of all the farm machinery sold in Canada. The rest is sold through independent distributors. The following analysis of wholesale distribution costs is confined mainly to the costs of these full-line and long-line companies.

Using data obtained from a financial questionnaire completed by all the major firms in the industry, and supplementing this with data obtained from company briefs and the Commission hearings, it has been estimated that the marketing costs of the larger firms currently amount to about 17 per cent of their net sales to dealers. These costs can be broken down as follows:

	Percentage of Manufacturer's Net Sales (1960-66 Averages)
Cost of branch operations	7.8
Advertising	1.3
Head office costs attributable to marketing	2.9
Investment costs (imputed)	5.0
Total	17.0

As these data indicate, the major marketing cost is the cost of running the branch offices. Another important component of costs is the cost of floor-planning new and second-hand machines in the hands of dealers. An estimate of the investment cost of carrying these inventories in the form of non-interest-bearing accounts receivable from dealers has been made, using an arbitrary 7.5 per cent interest cost.[9]

[9] The total cost in dollars was estimated by applying this 7.5 per cent to the average amount of dealer receivables outstanding. This amount calculated as a percentage of total net sales provided the estimated 5.0 per cent.

A somewhat more detailed breakdown of the branch office costs is given in Table 10.8. This table also shows the decline in this cost ratio over the period 1962 to 1966 as sales increased by 75 per cent. As this analysis shows, a major part of branch office costs are for blockmen (district or territory managers). Salaries and travel costs of blockmen were estimated at about 2.7 per cent of sales in 1966. The functions performed by blockmen were described in some detail above. Another significant component of branch office costs is that of the salaries and travel costs of technical personnel "who spend most of their time in the field instructing dealers and, to some degree, farmers in the field assembly of MF machines, their adjustment, operation, maintenance and repair".[10] The branch also stocks repair parts and new machines, and serves as the administrative and sales headquarters for the region.

There is some basis for believing that there are economies of scale in wholesale distribution. For instance, there is direct evidence that selling expenses as a percentage of sales decline as the level of total sales increases. The Commission's analysis suggests that selling expenses for a firm with annual sales of $20 million would be about 10 per cent of net sales, compared with 7.2 per cent for a firm with annual sales of $60 million.

TABLE 10.8– BRANCH OFFICE MARKETING COSTS AS PERCENTAGE OF NET SALES, NINE MAJOR FULL-LINE AND LONG-LINE FARM MACHINERY MANUFACTURERS, CANADA, 1962 AND 1966

	1962	1966
Index of domestic sales[1]	100	181
	Percentage of Net Sales	
Personnel costs, including travel		
Sales (mainly blockmen)	3.2	2.6
Technical	1.4	1.1
Repair parts	0.9	0.7
Wholegoods	0.7	0.6
Administration	0.9	0.7
Total personnel costs	7.1	5.7
Occupancy costs	1.0	0.9
Miscellaneous (postage, telephone, stationery)	0.5	0.4
Total branch accounted operating costs	8.6	7.0
Imputed investment costs		
Wholegoods and repair parts inventories and dealer receivables	6.0	5.0
Total branch office costs	14.6	12.0

[1] Data are for eight companies.
Source: From D. Martinusen and B.P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 7.5.

[10] Massey-Ferguson Industries Limited, *Brief to the Royal Commission on Farm Machinery*, Ottawa, January 1968, Vol. I, Ch. V, p. 17.

Further, an analysis of the function performed by blockmen suggests that economies of scale may be present and that these economies relate to the average size of dealership. The larger companies apparently have one blockman for every 8 to 12 dealers. Small companies have one blockman for every 12 to 15 dealers. Assume that the cost to the company of such a person is $20,000 for salary, fringe benefits, and travel expenses. If each blockman calls on 10 dealers, the average cost per dealer will be $2,000 annually. This is 2 per cent of sales for dealers selling $100,000 annually compared with 4 per cent where annual sales are only $50,000. To some degree, where sales are smaller a blockman may cover a larger number of dealers. But some officials suggested at the Commission's public hearings that the number of dealers under the supervision of one blockman may be related more to the size of the territory covered than the total sales volume. There may well be similar economies in technical personnel and other branch-house costs where the average size of dealer increases. In fact, average sales per dealer in 1966 for 10 full-line and long-line companies varied between $22,000 and $137,000.

The reduction in selling costs as a percentage of sales as total company sales increase probably reflects the fact that companies with larger sales have larger dealers. In other words, much of the economies of scale obtainable at the wholesale level may result from the economies obtained from servicing and supporting a smaller number of larger dealers. There is a fairly strong relationship between the size of a company's total sales and the average size of its dealers. In addition, some overhead costs such as central and branch-house inventory costs may decline as a percentage of sales as total sales volume increases, with average sales per dealer held constant.

Support for this view is also provided by an analysis of the distribution costs incurred by C.C.I.L. C.C.I.L. distributes its products through 60 large depots. In 1966, average sales per depot were about $250,000, measured in terms of wholesale prices of new machines and repair parts. This contrasts with annual sales per dealer of $137,000 for the private company with the largest dealers and an average of $91,000 for 10 full- and long-line companies. Yet C.C.I.L.'s distribution costs, shown in their financial statement under the heading of "sales, service, parts administration, administration and general expenses", over the period 1960 to 1966 amounted to only 2 per cent of sales. This compares with the private companies' branch-operating costs of 8 per cent. Compared with most of the full- and long-line firms, C.C.I.L. is a comparatively small firm, having sales in 1966 of new machines and parts at wholesale prices of about $14 million. Too much should not be made of this difference, because C.C.I.L. operates on a somewhat different basis and is only now introducing the equivalent of blockmen. Still, the results are suggestive. A comparison of the level of selling, general and administrative costs for C.C.I.L. and a selected number of other firms or groups of firms is given in Table 10.9.

Another important area of cost at the wholesale level is the cost of carrying parts and wholegoods inventory, including the cost of floor-planning new and used machines in the hands of the dealer. There is evidence that this cost area also

TABLE 10.9–SELLING, GENERAL AND ADMINISTRATIVE EXPENSES, SELECTED CANADIAN AND INTERNATIONAL FARM MACHINERY COMPANIES, 1960-67

(Percentage of wholesale sales)

	1960	1961	1962	1963	1964	1965	1966	1967
Financial questionnaire – major Canadian companies	10.4	11.5	10.1	8.6	7.8	7.2	7.0	
Financial questionnaire – complete sample of Canadian companies	12.2	12.8	11.2	9.7	8.8	8.3	7.9	
Deere & Company	12.8	12.4	12.0	11.4	11.8	11.1	10.3	10.6
International Harvester (Chicago)	11.2	12.0	11.0	11.5	10.6	10.7	10.5	
International Harvester (Canada)	10.3	11.1	10.3	9.5	8.8	8.4	7.8	7.8
Massey-Ferguson Limited	12.4	13.0	12.9	12.7	12.0	12.3	12.1	
Versatile Manufacturing Limited					2.5	4.9	3.8	3.9
C.C.I.L.	1.7	2.3	2.3	1.7	1.3	1.5	2.8	3.3

Source: R. Simkin, *The Prairie Farm Machinery Co-operative,* Royal Commission on Farm Machinery, Study No. 5 (Ottawa: Queen's Printer, 1970), Table C.2.

declines as the average size of dealer increases. Inventory turnover rates increase as the average size of dealer increases. Reference has already been made to the fact that in the *Cost of Doing Business Study,* inventory turnover rates for the largest class of dealers were shown to be 50 per cent higher than those for the smallest class. A similar increase in turnover rates is evident from Canadian Census data for all dealer sales categories up to the very largest (see Table 10.5).

As Table 10.10 shows, turnover rates for distribution assets tended to rise as total industry sales increased from 1960 to 1966. On the other hand, the average turnover rate for the four largest companies in Group I was consistently lower than that shown by the six companies in Group II, despite the fact that the average dealer size in the latter group of companies was appreciably smaller.[11] However, the picture is muddied by the fact that more of the franchises granted by Group II companies would be joint dealerships, so the average size of the dealers would in fact be larger than shown by averages based on individual companies' sales. Turnover rates for distribution assets are still higher for Versatile and the Group IV companies. The comparatively high turnover rates for the smaller firms in Group IV undoubtedly are due to the relative absence of interest-free floor-planning arrangements for this group of companies. Versatile's turnover rate for distribution assets has been declining as it has had to introduce interest-free floor-planning arrangements to compete with the established firms. Turnover rates vary widely between different companies, ranging from 0.9 to 1.8 for Group I companies and

[11] The composition of each of these groups is described in Chapter 12.

from 0.9 to 2.0 for Group II companies. Some of these differences between different companies may reflect company policy and product mix.

TABLE 10.10–TURNOVER RATES OF WHOLESALE DISTRIBUTION ASSETS OF CANADIAN FARM MACHINERY FIRMS, BY GROUP, 1960-66

	Group I[1]	Group II[1]	Group III[2]	Group IV[3]
1960	1.0	1.1	n.a.	2.8
1961	0.9	1.3	n.a.	2.9
1962	1.1	1.4	n.a.	4.2
1963	1.4	2.0	3.3	2.8
1964	1.5	1.9	2.7	3.8
1965	1.4	1.9	2.5	4.0
1966	1.3	2.1	2.1	3.8
Average	1.2	1.7	2.4	3.6
1967			1.7	
1968			1.5	
Average 1963-68	n.a.	n.a.	1.9	n.a.

n.a. – not available.
[1] Three companies in Group I, 5 in Group II.
[2] From *Annual Reports* of Versatile Manufacturing Ltd. Based on total sales to accounts receivable since inventory figures were not broken down between factory inventories and distribution inventories. However, it is likely that accounts receivable cover the majority of wholesale distribution assets in the case of Versatile.
[3] Consisting of 3 companies in 1960, 5 in 1961 and 1962, and 6 from 1963 to 1966.
Source: D. Martinusen and B.P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 7.9.

If it is true, as has been argued above, that wholesale distribution costs decline appreciably as the average size of dealer increases, there must be room for considerable further savings in this area. As was demonstrated in Table 10.5, the small dealers who account for approximately the bottom 30 per cent of total sales constitute about 60 per cent of all dealers. Suppose all of these dealers were eliminated over the course of a number of years and their sales redistributed among the larger dealers. Average sales per dealer of the remaining dealers (for new machines and parts at wholesale prices)–those who now account for 70 per cent of company sales–would increase from $196,000 to $282,000 (as of 1966). If costs for blockmen vary directly with number of dealers, this cost would fall from its 1966 level of 2.6 per cent of sales to about 1.1 per cent. Other personnel costs would probably fall too, but by a smaller extent. Let us suppose they decline by 20 per cent, or by about 0.6 per cent of sales. Thus the reduction in dealer numbers would provide a saving at the wholesale level of around 2 per cent of sales. There might also be some saving on company-held inventory. In addition, since inventory turnover rates for large dealers are significantly higher than for small dealers, there would be some additional saving on the cost of floor-planning dealer wholegoods inventory. Thus the total saving could range from 2 to 2.5 per cent of sales.

However, to the extent that this neglects the existence of joint dealerships it may contain some element of overestimate.

The other element of marketing cost, advertising, is comparatively small. The 10 full-line and long-line companies in Groups I and II of the Commission's financial questionnaire reported advertising expenditures averaging between 1 and 2 per cent of manufacturer's net sales. This percentage declined for all firms over the period 1960 to 1966 as advertising expenditures remained fairly constant in spite of an 80 per cent increase in sales. There is also a marked variation in the level of advertising expenditures for different firms. As a percentage of sales, expenditures ranged from 1.2 to 2.5 per cent in 1962 and from 0.6 to 2.4 per cent in 1966. Moreover, there is little evidence that higher advertising expenditures are accompanied by larger market shares.

Although no complete information for the industry is available, there has apparently been a substantial decline in the number of wholesale branches operated by the older established companies. Massey-Ferguson reported that it had reduced the number of its branches from 15 in the 1940s to 5 in 1966. This decline occurred during the period in which the company was changing from an agency to a dealership basis of operation, with the number of agents or dealers declining from 1,957 in 1944 to 720 in 1966. Total employment at its branches declined from a level in the early forties of about 1,500 (together with an additional 1,500 temporary staff in the fall) to about 450 in 1966. Although the reduction in the number of branches undoubtedly provided some saving, a large part of the total saving must have been due to the change from the agency to the dealership system, with the dealers assuming many functions formerly carried out by the branch.

Offsetting the decline in branches operated by the older companies would be the establishment of new branches by recent entrants to the industry such as New Holland, New Idea, and David Brown. New entrants usually operate through an independent distributor when they first begin to sell in the Canadian market, but when they become well established they often set up their own wholesale distribution network. This may occur with annual Canadian sales as low as $500,000.

U.S. Census data indicate a comparable decline in manufacturers' wholesale distribution outlets. The number of these branches declined from 330 in 1939 to 223 in 1963 (see Table 10.11). Most of this decline occurred between 1954 and 1958. These wholesale outlets also experienced a sharp decline in operating expenses as a percentage of sales, from 15.6 per cent in 1939 to 6.9 per cent in 1963. Some of this decline may reflect the shift from an agency to a dealership basis of operation, although, for some companies at least, the change to a dealer system occurred as early as the 1920s in the United States. The Census data also show a sharp increase in sales (at constant dollars) per employee and a marked increase in the inventory turnover ratio. On the employment side there was evidently a major structural change between 1954 and 1958 with employment declining one-third. The increase in inventory turnover undoubtedly reflects the

TABLE 10.11 – TRENDS IN U.S. MANUFACTURERS' SALES BRANCHES AND OFFICES, 1939-63

	Number of Establish-ments	Total Sales	Inventory	Inventory Turnover Rate	Total Sales at Constant Prices[1]		Employment	Sales Per Employee at Constant Prices[1]		Operating Expenses
		(Current $ millions)			($ million)	(Index 1939 = 100)		(Dollars)	(Index 1939 = 100)	(Per cent)
1939	330	291.0	51.1	5.7	418.1	100	12,396	33,729	100	15.6
1948	302	1,510.0	112.6	13.4	1,489.2	356	14,565	102,245	303	5.7
1954	299	1,292.9	204.3	6.3	1,058.0	253	13,512	78,300	232	8.6
1958	221	1,419.6	110.6	12.8	1,020.6	244	9,031	113,011	335	6.4
1963	223	1,685.7	149.8	11.2	1,094.6	262	9,122	119,996	356	6.9

[1] Deflated by U.S. Department of Labor, Wholesale Prices and Price Indexes (Agricultural Machinery & Equipment), 1947-49=100.

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 8.10.

introduction of interest-free floor-planning which effectively moved inventory from branch yards and warehouses to dealer premises. The investment cost of this interest-free floor-planning would not appear in the operating expenses of the sales branches. Thus the 6.9 per cent shown for operating expenses in 1963 would be comparable to the 7.0 per cent for 1966 in Canada (see Table 10.8). The data are not fully comparable; the U.S. Census data are based on a complete industry survey, whereas the Canadian data are for large firms which account for about 75 per cent of Canadian sales.

Suppose there were a smaller number of firms marketing farm machinery in Canada. Would there be significant savings in wholesale distribution costs? While it is not easy to give a conclusive answer to this question, the Commission's analysis suggests that the savings would not be large, and most of those that did occur would reflect a shift towards a larger average size of dealer. Thus, even if all of the six firms in Group II (see Table 12.24) were amalgamated or merged with the four firms in Group I, the total sales of the latter group would only increase by 35 per cent. In fact, the sales in constant dollars of Group I increased by twice this amount between 1961 and 1966 simply from the normal expansion of the market. An amalgamation of the type suggested would undoubtedly result in a major consolidation of dealers such as occurred for Cockshutt and Oliver dealers after the two firms were taken over by the White Motor Company in the early sixties, with a resulting increase in average dealer size. However, as has been suggested above, a good deal of this dealer consolidation can and may occur within companies, and this is not dependent on a reduction in the number of competing companies.

The Role of Co-operatives in the Distribution of Farm Machinery

Co-operatives now are a significant factor in the distribution of farm machinery in two parts of Canada,-Quebec and Western Canada. In Quebec the Coopérative Fédérée de Québec distributes farm machinery throughout the province, selling mainly through local co-operatives. In 1965 it supplied about 10 per cent of all farm machinery and parts sold in Quebec. The Coopérative Fédérée sells a wide range of farm supplies to its members, and farm machinery accounts for only about 3 per cent of this total–in 1966, some $4.7 million. In Western Canada, C.C.I.L., whose competitive role has already been outlined, currently sells about $20 million of farm machinery and parts, of which somewhat over half is manufactured in its own factory. It is one of the few co-ops anywhere in the world that both manufactures and sells farm machinery.

The decision to establish a co-operative for the production and distribution of farm machinery was a direct result of a recommendation contained in the Report of the Special Committee on Farm Implement Prices, House of Commons, 1937. They had expressed the view that "there is competition in the matter of sales with little effective competition in the matter of prices" and that "the cost of distribution of farm implements is unnecessarily high". They suggested that "farmers should be encouraged to organize for the co-operative distribution and servicing of farm

implements". The initial response to the proposed co-operative was disheartening. In the first membership drive only \$50,000 was raised. However, after several subsequent drives, an amount in excess of \$750,000 was obtained.

The proposed co-operative faced formidable difficulties. At the end of the Second World War, farm machinery was in short supply throughout the world, and existing North American companies were reluctant to supply equipment to this new competitor. Moreover, to begin manufacturing a complete line of equipment from scratch was no easy task. As a result there was considerable doubt in the minds of the directors of the new organization as to the correct course to pursue. Two related developments provided a solution to C.C.I.L.'s problem. The Cockshutt company was contemplating the production for the first time of a tractor and a self-propelled combine. At the same time 12 large co-operative wholesale firms in the United States had joined together to form the National Farm Machinery Co-operative with a view to manufacturing a line of farm machinery. Although Cockshutt was reluctant to supply C.C.I.L. with farm equipment that could be sold in competition with their own dealers, they agreed to do so when C.C.I.L. was able to persuade National to distribute Cockshutt tractors and combines (under the Co-op brand name) in the United States. This additional volume was needed to help ensure the success of Cockshutt's new venture. However, to protect its own dealers, Cockshutt initially allowed C.C.I.L. a discount of only 24.6 per cent off list price instead of the 40 per cent that is more usual for a distributor.

Alternatives that were considered at that time included the outright purchase of Cockshutt either by C.C.I.L. and National jointly, or by C.C.I.L. alone but with an agreement by National to purchase part of Cockshutt's output. One disadvantage of both of these proposals was the fact that Cockshutt had fairly large sales in Eastern Canada and there was no co-operative organization in that area prepared to assume responsibility for these sales. In the event, it was fortunate that C.C.I.L. did not enter into an agreement with National, since the latter failed in 1952, with a loss of over \$3 million, and the 12 wholesale co-operatives who had sponsored it gradually discontinued their farm machinery business, the last one dropping out in 1962.

In the meantime, C.C.I.L. had purchased a small farm machinery factory in Winnipeg and began to manufacture some machines of its own. These included a number of new machines development of which C.C.I.L. pioneered, such as the "disker", the "harrower" and a folding harrow drawbar. In subsequent years, other implements were added to its line and it now manufactures a fairly extensive line of equipment except for tractors, including finishing off self-propelled Volvo (Bolinder-Munktell) combines and the manufacture of a PTO combine built around the Volvo threshing body.

Some years later, in 1962, when the White Motor Company acquired control of Cockshutt and stopped supplying equipment to C.C.I.L., the latter was able to supplement equipment of its own manufacture by importing combines, tractors, and other farm equipment from Western Europe. Improvements in handling these

machines and loading them on board ship, together with the reduction in transport costs as a result of the completion of the St. Lawrence Seaway, helped facilitate this shift to a European source of supplies. In addition, the advent of jet aircraft has made possible the prompt delivery of emergency parts. Mr. John B. Brown, until recently the President of C.C.I.L., reported that emergency parts ordered from West Germany are delivered in Winnipeg the next day, as quickly as they ever were from Cockshutt in Brantford.

One of the objectives of the original founders of C.C.I.L. was a reduction in the costs of distributing farm machinery. To achieve this goal they early decided to confine their distribution network to a limited number of strategically placed depots. By 1952, some 22 depots were in operation. After a pause during the low sales and profit years after 1953, the depot organization was gradually expanded, reaching its present level of 60 depots in 1966. These depots, located in larger trading centres, provide sales and service, maintain a stock of parts, and recondition used machinery. In some ways these depots are comparable to the stores maintained in some centres by major companies. As such, they are admittedly less efficient than the independent dealer with a comparable trading area. In part, this reflects the fact that an individual in business for himself will work harder and longer hours than a salaried employee. In part too, with salaried employees, trade-in losses may be difficult to control. Average sales per depot for new equipment and parts are now about $300,000.

The depot system has provided assurance of good service and parts supply. It has frequently provided stand-by machines, often used machines, in case of machine breakdowns in critical periods. The system has also facilitated the movement of second-hand equipment from the southern half of the Prairies to more northern areas where farms are smaller, and demand for second-hand machines is larger. Nevertheless, it has apparently not reduced distribution costs as much as had originally been anticipated. The Co-op has discovered that it has had to sell and promote its machines in much the same way as the privately owned companies.

In establishing list prices for its machines, C.C.I.L. has largely followed the practice of the trade and has priced its products at levels very close to those of competitive models, after appropriate allowance for special features or qualities of the various makes. Initially, when it was distributing Cockshutt machines it was required by its agreement with that company to adhere to the list prices announced by Cockshutt. In the early postwar years when equipment was scarce, list prices were generally adhered to and any trade-ins that were accepted were sold readily, often at a premium. However, after sales fell off sharply in the mid-fifties, the practice of over-allowing on trade-ins became general. In 1966 C.C.I.L. reported losses on trade-ins amounting to about 23 per cent of their gross sales of new equipment. Mr. Brown expressed the belief that this was larger than was general in the farm machinery trade.

For the 1968 selling season, C.C.I.L. adopted a new pricing policy. This was reported in their submission to the Commission as follows:

> . . . From now forward all our price lists will contain two prices for every machine. One, the "list price", will be in accordance with present pricing practice of the major machine companies, the other will be the "cash price". . . . In sales in which trades are accepted in part payment both the above prices will be stated and also the estimated market value of the trade, and this, plus the costs of handling and selling the trade will be deducted from the "cash" price.[12]

The surplus earned by C.C.I.L. has been distributed to its members, partly in the form of cash dividends, partly in the form of additional shares. Since 1952 no cash dividends have been paid. However, beginning in 1962 members have been allowed to use the shares they have been allotted as part payment for new machines, within limits. Since 1958, savings have averaged over 10 per cent of list prices or around 14 per cent of prices actually paid. More than $3 million of share dividends have been applied to the purchase of new equipment. From C.C.I.L.'s viewpoint, payment of dividends in the form of shares allows the co-operative to accumulate additional capital. By October 1966, members' equity had risen to $11.4 million, and this has gone a long way to help finance the large inventory and other capital investment required in this industry. C.C.I.L.'s total inventory in October 1966 amounted to just over $13 million. From the members' viewpoint, the share dividends are less rewarding, since the shares yield no interest return, and if they are to be redeemed only at some future date, they must bear a heavy discount. Thus a significant part of the savings (profits) reported by C.C.I.L. should be considered a return on the capital invested in the business. If a return of 6 per cent were imputed on members' equity over the 20-year period from 1946-66, it would account for about one-third of total reported savings.

While not a major competitive factor in the western farm machinery market, C.C.I.L. is still a significant influence. Up until 1960 its annual sales were from 2.5 to 3.5 per cent of the Prairie total. However, as a result of a rapid expansion of sales during the past few years it now supplies from 5 to 6 per cent of this market. This increased market share may well reflect the completion of C.C.I.L.'s depot network. The Co-op pioneered in the movement towards fewer and larger distribution depots, a pattern that now is becoming more general in the industry. It took the lead in the development of several important new machines, although as a whole the research and development side of its operations appears relatively weak. It has also provided an opportunity for well-established European manufacturers of tractors and combines to enter the Canadian market. All this has been accomplished with relatively little help from the other large well-established co-operatives. In view of the frequent failures that co-operatives have experienced in the farm machinery business, C.C.I.L.'s success is a creditable achievement.

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[12] C.C.I.L., *Brief to the Royal Commission on Farm Machinery,* Ottawa, December 13, 1967.

Recently, C.C.I.L. has introduced, on an experimental basis, a plan providing for large discounts on cash sales without trade-ins. The plan also offers additional discounts where orders are placed in advance. The discount ranges from 30 per cent for a cash sale, with immediate delivery, to 42 per cent for a cash sale, with delivery 12 months later. The discount rises one percentage point for each additional month's advance notice given. Individual members must sell their own potential trade-ins but may do so at periodic auctions held by C.C.I.L.

Turning now to the experience of the Coopérative Fédérée de Québec, a somewhat different pattern is evident. Coopérative Fédérée has long had a franchise for the distribution of Oliver products in Quebec. In addition, since 1960 it has been selling Renault tractors. It also distributes a variety of hay, potato, irrigation, and other equipment for a number of short-line companies. About 70 per cent of its total purchases of farm machinery is supplied by Oliver.

Coopérative Fédérée in turn distributes its machinery primarily through local co-operatives, although it makes a few sales directly to farmers, and about one-fourth of its sales are through local dealers who are not co-operatives. It now has about 100 licensed dealers, but many of these sell only a small amount of machinery. In 1967, almost half of these purchased equipment valued at $40,000 or less, and only about 9 per cent made purchases in excess of $100,000. The local co-operatives are controlled by their own members and are largely independent of the Coopérative Fédérée. This distribution pattern follows closely the one that C.C.I.L. first contemplated but rejected in favour of the depot system.

Although the Coopérative Fédérée supplies about 10 per cent of all the farm equipment sold in Quebec, and its total sales have more than doubled in the past ten years, this has not been a profitable business for it. Only in 1965 and 1966 did it show a net profit, and even then, profits were relatively small—$39,000 in 1965 and about $105,000 in 1966. Although its share of the Quebec market has been larger than that of C.C.I.L. on the Prairies, the business as a whole has clearly been much less profitable. Part of this may reflect the profits that accrue to C.C.I.L. on the manufacturing end of its business. However, in part, too, it may reflect the economies that C.C.I.L. gains from its more rationalized distribution network. Then, too, for Coopérative Fédérée, sales of farm machinery are only a small part of a large wholesale business covering many types of farm supplies.

On the evidence available it is far from clear just how much the co-operative distribution of farm machinery in Quebec affects the pattern of competition. In the absence of the Coopérative Fédérée, its major supplier, the Oliver Corporation, would undoubtedly have its own network of dealers. On the other hand, as a distributor of Renault tractors and other short-line products, Coopérative Fédérée undoubtedly facilitates the entry of these products into the Quebec market. Thus its presence adds something to the level of competition and provides a potential for further competition. As such, it should be encouraged to maintain an active role in the distribution of farm machinery.

Chapter 11

RETAIL AND WHOLESALE FINANCE

During the postwar period all the major farm machinery firms have become increasingly involved in the finance of farm machinery at the retail or wholesale levels or both. Wholesale finance is defined as the finance of new machines, attachments, and parts, in the hands of the dealer. Retail finance is defined as the finance of sales to the final consumer. Each of these will be discussed in turn.

In this chapter, finance will be considered as a cost and competitive factor in the industry. The problem faced by the farmer in financing his purchases of machinery will be examined in a later chapter.

Wholesale Finance

Before the farm machinery companies changed from the agency to the dealership basis of operation in the early or mid-forties, the companies typically shipped new machines and parts to their agents on consignment, with the company retaining ownership of the machines and parts until they were sold. In this period, many of the machines were stored in regional branch warehouses and were shipped to their final destination only after the sale was completed. When the agent became an independent dealer, new machines and parts were sold to him by the company on fairly short terms and he had to assume responsibility for financing his inventory of machines and his parts supply. In addition, he had to finance shop facilities, service tools, and transport equipment. At the time the transition to this new arrangement occurred, the problem of financing the dealer's inventory created no serious problems because machinery was in short supply, and new stock did not remain for long on the dealer's premises. In addition, trade-ins (if there were any) could be readily resold because of the general shortage of machinery.

By the early fifties, the general shortage of farm machinery—a legacy of the war and the Great Depression—had disappeared, and sales of machinery slumped sharply. In the much more competitive market that developed at the dealer level, many dealers began to experience difficulty in financing their inventory, and tried to economize by stocking fewer machines. The farm machinery manufacturers were unhappy about this development. New machinery was typically produced well in

advance of the date of its final sale, and each manufacturer felt that unless its machines were kept constantly in view at the dealer level, it would lose sales to competitors whose machines were on view. Moreover, one major manufacturer, John Deere, had continued to ship its machines to its dealers on a consignment basis in Canada, and the other companies undoubtedly felt that this placed their dealers at a competitive disadvantage.

As a result, all the major full-line and long-line firms introduced the practice of floor-planning new machines and attachments in the hands of the dealer on an interest-free basis. Under these arrangements, new machines would be provided to the dealer free of interest for periods up to 23 months or until the date of sale. Generally limited to machines and attachments with an invoice price in excess of $100, floor-planning arrangements were later extended to second-hand machinery taken in trade. Deferred credit terms were also provided on dealer purchases of parts under special arrangements designed to encourage the dealer to order parts well in advance of the season of use and maintain an adequate stock to service his customers.

Under free floor-planning arrangements, the dealer is typically obligated to the company under a one-year interest-free lien note. For tractors, the note normally matures one year from date of shipment. For other machines, the note becomes due 12 months following the end of the established season of use. Thus, on a combine, whose established season of use is defined by the company as June 1 to September 30, payment would not become due on a shipment received in October until 12 months after the following September 30; in effect giving the dealer up to 23 months in which to dispose of the machine before he was obligated to pay interest to the company. While dealers would not normally order new machines that far in advance of their normal season of use, the effect of the plan is to provide the dealers with two selling seasons in which to dispose of the machines. It is clear that floor-planning arrangements provide the dealer with more incentive to stock machines on his premises since the company finances this part of his business. Other things taken as equal, this undoubtedly gives the dealer a sales advantage because his machines are on view and the farmer can obtain immediate delivery. Immediate availability is also an advantage to the farmer, who may wish to defer a purchase decision until just before the machine is needed. Since the time any machine is replaced can be varied within rather broad limits, he retains the freedom to make his old machine last another year if the crop or market outlook is adverse by deferring his purchase decision until the season of use. However, machines stored on the dealer's premises or elsewhere may deteriorate to some degree before they are finally sold.

Floor-planning arrangements also undoubtedly add something to the cost of machinery and to the price eventually paid by the farmer. In its submission to the Commission, Massey-Ferguson claimed that floor-planning was provided at substantial cost to the company. However, when they were asked to explain the difference

between prices of tractors in Britain and Canada, the cost of floor-planning was cited as one of the reasons for the higher price of tractors in Canada—in effect, stating that the cost was passed on to the customer. According to their estimate, on one of their MF 135 tractors, the cost of floor-planning amounted in 1967 to $195, or about 5.5 per cent of the suggested retail price. This estimate includes the cost of floor-planning on both the new tractor and the used tractor taken in trade, and is based on their experience that—on the average—a new tractor in Canada is floor-planned for six months. It also includes the cost of insurance on the floor-plan. Ford estimated the cost of financing its inventory of new and used goods in the hands of dealers at around 7 per cent of the value of sales at the suggested list price. International Harvester estimated that tractors imported from Britain were floor-planned in the hands of the dealer for an average of nine to ten months. The company attributed this, in part, to the fact that a substantial number had to be brought in by ship before freeze-up in the fall because tractors delivered in the spring might not reach the dealer's premises in time for the spring marketing season. Since floor-planning on other machines may extend over a period of 23 months, whereas the maximum for tractors is 12 months, this additional cost for such machines may at times be higher than for tractors. However, dealer operating statements suggest that year-end inventories of new machines are the equivalent of about four months of sales. Since inventory levels are probably low at the year-end, the average amount held in inventory may well be higher than this—perhaps in the order of five or six months of sales. In brief, it appears that floor-planning costs vary from 5 to 7 per cent of the suggested retail price of farm machinery.

Some part of these costs are undoubtedly an inevitable component of the cost of supplying farm machinery to farmers. Given the marked seasonal pattern that characterizes the sale of most machines (a pattern that results from the farmer's predisposition to defer his purchase to the last possible moment) and given the necessity that the companies find of producing machinery well in advance of sale (in order to be able to meet anticipated demand and yet keep their production costs down by producing in sufficient volume to attain reasonable economies of scale), there will be a cost of carrying this inventory from the date of production until it is finally sold to the farmer. By including these costs in the price to the dealer and providing interest-free floor-planning arrangements, dealers are given an incentive to carry larger inventories. But the dealer has little incentive to economize on the use of inventory except to the extent that larger inventory may carry a risk of loss through obsolescence. To the degree that the dealer is induced to carry larger inventories than he would if he had to absorb the interest cost, something may be added to the over-all cost of doing business. Dealer inventory turnover over the past 15 years has tended to decline in years of rising sales and increase when sales slump (see Table 10.7).

British farmers and distributors are apparently able almost completely to avoid interest-free floor-planning costs on tractors because a farmer typically orders his tractor from the factory and the dealer delivers it as soon as it arrives. The

existence of large factories producing tractors for a worldwide market undoubtedly facilitates this arrangement. However, there would appear to be no reason why the farm machinery companies supplying tractors from Europe should not offer to order tractors from the factory for Canadian farmers at a price that is reduced by the amount of normal floor-planning costs. Whether many farmers would take advantage of this arrangement is open to question. Nevertheless, I would recommend that the companies should experiment with some such plan. There would appear to be less scope for a similar arrangement for tractors produced in North America, since sales of these larger tractors are concentrated in North America and are highly seasonal. To achieve reasonable economies of scale, firms must produce tractors on a year-round basis, thus making almost inevitable an accumulation of inventory during the slack sales season. A similar conclusion applies to many of the other machines produced and sold in North America.

Retail Finance

Prior to the Second World War, the banks and the farm machinery companies were the major sources of credit for the finance of farm machinery. Because of their serious bad-debt losses and collection difficulties in the 1930s, the farm machinery companies partly withdrew from the finance business and have only gradually returned to it. The decision to withdraw was facilitated by the fact that at the end of the war many farmers had ample liquid funds in the form of cash or savings bonds. In addition, the introduction of the *Farm Improvement Loans Act* (F.I.L.A.) in 1944 provided farmers with an alternative source of finance at a much lower cost.

Under this Act, the government provided a guarantee against losses of up to 10 per cent of the value of loans made under the Act. In its original form, the only institutions eligible for this guarantee were the chartered banks. Loans to each farmer were limited to $3,000; the interest rate was limited to a maximum of 5 per cent per year simple interest; and loans on farm implements were limited to a maximum term of three years and to no more than 75 per cent of the cash price of the implement. The legislation proved very successful, and within a few years of its introduction, loans under the Act for the finance of farm machinery were running at a level around one-third of the wholesale value of new farm machinery sales. (Because some of these loans were used to finance second-hand machinery, the percentage of the value of new machines financed under the Act would be lower than this.) From 1945-67 about 80 per cent of loans made under the Act were for farm implements.

In the ensuing years, the Act was revised to raise the loan limits for individual farmers to $4,000 in 1953, $5,000 in 1956, to $7,500 in 1959, and to $15,000 in 1964. Although there have been periodic complaints that the loan limits had been set too low, a Department of Finance survey indicated that in 1967 only 6 per cent of the loans were for amounts in excess of $5,000 and that there had only been one loan in excess of $10,000. Although individual machines may be priced at $15,000

or more, the farmer typically trades in older machines so the net balance owing is usually well below the cash price. Even in 1967, the average size of loan was only $2,600.

To some degree, the absence of larger loans may reflect a conflict between normal banking practice and the guidelines for the term of lending given in the regulations to the Act. These regulations suggest the following pattern:

Approximate Amount of Loan	Normal Repayment Period
$ 1,000	2 years, 6 months
2,500	4 years
5,000	6 years, 6 months
7,500	8 years
10,000	8 years, 6 months
15,000	10 years

Sound finance practice would consider that the term of the loan should be related to the life of the asset rather than the size of the loan. However, the longer term suggested for the larger loans would undoubtedly make it easier for the young farmers to make major machinery acquisitions.

The most recent amendments to the Act replaced the 5 per cent interest-rate ceiling with a regulated rate, established an over-all maximum loan limit of $25,000 but retained the $15,000 limit on loans for the purchase of farm machinery, and extended the range of lenders eligible for the guarantee to include loan, trust, and insurance companies, credit unions, and caisses populaires. Prior to the removal of the interest-rate ceiling, there had been some decline in bank lending under the Act as rising interest-rate levels made these loans relatively unattractive to the banks. With the removal of the ceiling, the banks as well as the other institutions that have recently become eligible for the government's guarantee will have more incentive to compete actively for the finance business involved in the sale of farm machinery. Over the past decade, F.I.L.A. loans have amounted to between 3 and 4 per cent of the chartered banks' general loans, suggesting that the banks could very easily make additional funds available in this area if they wished.

Although no exact figures are available on the extent to which the sale of new farm machinery is financed by the farm machinery companies themselves, there is evidence that this has increased substantially in importance in recent years. One estimate prepared for the Commission suggests that about 60 per cent of the value of new farm machinery sales were financed by credit in 1963.[1] Of this total, it was estimated that the chartered banks financed about one-half, the farm machinery companies 16 per cent, finance companies 12 per cent, and all other sources about 20 per cent. However, other evidence suggests that this estimate of machinery-company finance may be low. John Deere reported that in recent years it has financed from 40 to 45 per cent of all its retail sales, New Holland reported that it

[1] R. Harris, *Farm Machinery Finance*, unpublished Commission study, 1969.

had financed 44 per cent of its retail sales in the 1966 crop year. Allis-Chalmers reported that it financed 15 per cent of its sales in 1964 and 31 per cent in 1966, and Case reported financing 35 per cent of its Canadian dealer sales in 1966. Massey-Ferguson said that in 1966, acceptance of time-payment contracts amounted to 47 per cent of sales in Canada and 37 per cent in the United States. In 1960, only 20 per cent of Massey-Ferguson's Canadian sales had been financed by the company. These totals apparently include credit extended under interest-free arrangements, even though the amount owing may be settled in full at the end of the interest-free period. Thus these data may overestimate the amount of credit extended for which a formal charge is being made.

The reason for this increase in the importance of machinery company finance is not entirely clear since F.I.L.A. loans provide a much lower-cost alternative. In terms of simple interest, most companies charge from 13 to 15 per cent per year, much more than the F.I.L.A. rate, which during the summer of 1969 was set at 7 ¾ per cent. To some extent, the relatively heavy use of machine-company finance must reflect the fact that the machinery companies find the provision of credit profitable and their dealers encourage customers to use it. In contrast, in the period just before the interest ceiling was removed, the chartered banks undoubtedly made little effort to sell farmers on the merits of F.I.L.A. loans. Some companies also report that a finance plan enables them to maintain and develop more accurate statistics of market trends and movements.

Increased competition in finance is reflected in the development of interest-free finance plans. The out-of-season form of this plan apparently originated in 1958 on the Prairies when one company found itself with a heavy carryover of combines in dealer hands and offered to sell these to farmers on an interest-free basis until just prior to the next season of use. The practice was continued and soon became general in the industry. Out-of-season sales are of significant advantage to both the dealer and the manufacturer. They provide the dealer with more time to adjust and check new machines prior to delivery. And the machines taken in trade can be reconditioned during the slack season and made ready for resale. For the manufacturer, it provides a reduced risk because machines have to be produced well in advance of sale in any case. The farmer may gain an advantage in the form of a better deal on his trade-in. He is also protected from interim price increases. It can be argued that the plan often costs the machinery companies virtually nothing, because the machines would have been floor-planned in the dealers' hand in any case.

Although the interest-free plans were at first applied only to sales in the off-season, they were later extended to in-season sales as well. Thus a farmer might buy a combine in August but would not be required to pay interest until a year later. In addition, he would receive interest on his cash down payment. This type of plan is apparently not used by all companies or by any one company on all its machines or in all years. It appears to be basically a sales-promotion device. In some respects, it amounts to a form of reduction from the list price, the amount of the

reduction being equal to the cost of funds to the company, perhaps 7 or 8 per cent per year. The over-all extent to which the plan is used is not known. One company reported that at the end of 1966, 40 per cent of its retail notes outstanding were on an interest-free basis, although this presumably includes both in-season and out-of-season plans. This compared with 30 per cent in the United States. The greater use of the plan in Canada may reflect the higher degree of seasonality here. To the degree that the plan becomes general, the cost may well be built into the price of machinery. However, when used sporadically, interest-free in-season finance probably represents a genuine price reduction to those who take advantage of the plan.

One company reported to the Commission privately that the in-season interest-free plan was adding very significantly to the cost of farm machinery. It induces farmers to defer trading in their combines and other machines until near the season of use to obtain the advantage of this plan. As a result, dealers are not able to recondition the trade-in for sale during the same season. Thus it results in traded-in machines sitting on dealer lots for an additional year, thus adding substantially to total costs.

The in-season plan appears to serve no useful purpose and it is recommended that its use be banned. The companies that wish to provide additional incentives for the purchase of their machines during the season of use can do so by outright price reductions.

To some degree, the development of interest-free finance plans may have discouraged the use of F.I.L.A. loans. If the farmer makes his arrangements at the date of the original sales agreement, it is possible to finance by means of a F.I.L.A. loan when the interest-free period ends. However, F.I.L.A. requirements do not allow the use of a guaranteed loan for refinancing purposes. If the farmer waits until the end of the interest-free period before applying for a F.I.L.A. loan, he is technically not eligible. Still, many farmers apparently secure bank finance under the Act at the end of the interest-free period. It would be desirable to regularize practice here, and it is therefore recommended that F.I.L.A. financing be made available at the end of the interest-free period granted by the farm machinery company.

Finance Subsidiaries

Many of the farm machinery companies have set up credit subsidiaries to handle their finance business. This enables them to borrow from banks or other financial institutions on the security of the retail or wholesale paper they write. Since the credit subsidiaries can be operated with relatively low ratios of equity to total assets—typically 12 to 14 per cent—and with a larger proportion of short-term credit, it undoubtedly enables the companies to obtain funds for finance purposes at a lower over-all cost. Many of the companies established their credit subsidiaries between 1955 and 1962. The effects of these finance subsidiaries on the companies'

over-all balance sheet and profit position is discussed in Chapter 12. This section of the Report examines the profitability of the subsidiaries as such.

Accurate measurement of the income earned by the companies on their finance business is made difficult by the fact that there are various methods of allocating the periodic payments made on finance contracts between interest and principal repayment. Different methods can give different time patterns of income over the life of a note. In addition, in periods when the companies' finance business is rapidly expanding or declining, reported earnings may understate or overstate their true return. In the former case, company balance sheets would include a substantial proportion of notes on which the first interest payment would not be made until the following year .The increasing prevalence of interest-free periods in the early months of any retail note tends to accentuate this problem. For example, in 1965, interest revenues on retail notes, expressed as a percentage of average year-end balances of retail accounts receivable, were as follows: Deere 7.3 per cent, Massey-Ferguson 9.8 per cent, International Harvester 8.7 per cent, and Case 5.5 per cent. The interest revenues reported are gross data before the deductions of operating expenses, although they may be net of dealer commissions (which one company has reported as 10 per cent of the gross finance charge). Since most companies charge the farmer interest at the rate of 13 to 15 per cent, it is clear that the returns reported above contain a substantial element of under-statement.

The profitability of finance subsidiaries is also affected by various parent-subsidiary charges. Two main types of charge are important. The parent company often charges the finance subsidiary for certain administrative services rendered on its behalf. In addition, the parent company makes a payment to the subsidiary to provide an interest return on certain interest-free dealer notes that the parent takes as part of its dealer floor-planning arrangement. The way losses on notes are shared further complicates the picture. The first charge arises because the various operations involved in finance, credit investigations, billing, and collections, are generally carried on partially or totally by parent-company personnel using parent-company facilities. The exact amount charged to the subsidiary is a matter of judgement, and is to some degree arbitrary. Where published information is available, it suggests that the amount of these charges in relation to total revenues are substantial and vary widely from one company to another. Company reports also indicate substantial variation in the ratio of interest revenues on wholesale notes to the amount of these notes outstanding.

Nevertheless, published information indicates that the finance business of the farm machinery companies is highly profitable. Data for five major companies for 1965 are given in Table 11.1. As these data show, before-tax profits earned by these companies on their finance business range from 32 to 40 per cent of their total revenues. It is clear that the profitability of this business is such that the companies have a strong interest in selling their finance plans to their farmer customers.

TABLE 11.1–INCOME STATEMENTS OF FINANCE SUBSIDIARIES OF FIVE MAJOR FARM MACHINERY FIRMS, 1965

(Percentage of total revenues)

	Deere	Massey-Ferguson	International Harvester	Case	White Motor
Interest revenues	100.0	100.0	100.0	100.0	100.0
Interest expense	46.5	34.4	41.2	51.0	57.4
Other expenses	18.1	31.3	20.2	9.0	10.3
Profit before taxes	35.4	34.3	38.6	40.0	32.3
Income taxes	17.1	16.9	19.7	18.6	15.8
Net income	18.3	17.4	18.9	21.4	16.5
Charges by affiliates for administration services included in "other expenses" above	n.a.[1]	30.0	14.8	n.a.[2]	8.6

[1] Compensation to Deere & Co. for administrative services in connection with handling retail notes on behalf of the Deere finance subsidiary is achieved by way of a deduction from the face value of notes by the parent. This deduction is taken into income by the parent as the notes mature. This method of compensating the parent company for administrative services is not readily comparable with that used by the other companies above.

[2] This figure will be under 9.0 per cent since the total of "other expenses" is 9.0 per cent.

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 8.6.

Besides being profitable, the provision of wholesale and retail finance by the full-line and long-line companies is also an important competitive factor in the industry. Floor-planning on an interest-free basis ensures that the company's products will be on view at dealer locations close to where the customer lives. It also makes the dealer highly dependent on the company whose franchise he holds, and undoubtedly makes him less willing to carry competitive products of short-line firms. The short-line firms typically sell their products to the dealer on fairly short terms. The dealer in turn may often finance this inventory through the banks or finance companies. If the dealer's financial position were stronger, he would be able to exercise more independence with a beneficial effect on competition in the industry generally.

Accordingly, the Commission recommends that the government introduce a guaranteed loan program for dealers similar in form to the F.I.L.A. This would encourage the banks and other financial institutions to make loans to dealers, thus strengthening the dealers' financial position. It would probably be desirable to limit the granting of guaranteed loans to dealers who had reached a reasonably efficient size–say, annual sales of not less than $200,000–or who showed promise of reaching such a size within a few years.

In view of the advantages that interest-free floor-planning arrangements give to the large company, it is recommended that the government make the floor-planning of new farm machines in the hands of dealers on an interest-free

basis illegal. To be effective, such a ban on free floor-planning arrangements would have to be accompanied by the elimination of consignment selling to dealers and provisions for minimum interest rates on the sale of new machines to dealers on a credit basis. The interest-free floor-planning of second-hand farm machinery should also be made illegal.

Rather than impose an outright ban on free floor-planning immediately, it would be desirable first to impose some limitation on its use. Initially, interest-free floor-planning might be limited to not more than six months on each transaction for tractors and to not more than one year for all other machines. This time limit might conveniently run from the date machines are shipped from the branch-house to the dealer. For second-hand machinery, a three-month limit might be imposed. After this limitation was in effect for a year or two its impact at the dealer level could be reassessed before proceeding with an outright ban.

If this proposal took effect at the same time as the proposed program of guaranteed loans to farm machinery dealers, it should avoid any undue hardship on dealers. Reasonable notice should be given of the introduction of these restrictions to enable dealers to reduce existing commitments. No restrictions should be placed on lenient or deferred credit terms for dealer purchases of parts.

The over-all effect of these proposals to restrict the use of interest-free floor-planning should be to make it easier for new or short-line manufacturers to establish themselves in competition with the larger full-line or long-line companies. It should also encourage more economy in the use of farm machinery inventory, and thus reduce the rather major cost to the farmer involved in interest-free floor-planning. Indeed, the companies themselves might welcome some limitation. When free floor-planning was first introduced, interest-rate levels were comparatively low. As market levels of interest rates have risen, this cost has steadily increased. It now adds significantly to the cost of distribution of farm machinery in North America.

With the elimination of interest-free floor-planning the farm machinery companies should be able to reduce their dealer prices to some degree because they would no longer have to finance wholegoods inventory in the hands of the dealer. A partial offset to this saving would be the additional inventory they might find it necessary to carry at the wholesale level.

On the retail side, it is clear that the F.I.L.A. not only makes it easier for the farmer to finance his purchases of machinery but also helps maintain a more competitive market structure for farm machinery. The loans available under this Act make it easier for the short-line manufacturers and the long-line firms without a finance plan to compete with the full-line firms. However, the rapid growth in finance under machinery-company plans during recent years suggests that F.I.L.A. loans have been less competitive than they were in earlier years. In part, this may have been due to the fact that the banks had little incentive to promote these loans when the 5 per cent interest-rate ceiling made the business unattractive to them.

With the higher rates now in effect, there may be some revival in F.I.L.A. lending, but it is too soon to tell. The decline in F.I.L.A. finance also reflects the fact that this is profitable business to the farm machinery companies: they sell it aggressively and their dealers have a financial interest in selling their company's finance plan. For example, under Massey-Ferguson's finance plan, the dealer receives 10 per cent of the gross interest charges, which would be something in the order of 1.3 to 1.5 per cent on the credit extended. Recently, a number of provinces have enacted legislation requiring all contracts involving time payments to state in terms of simple interest the interest rate charged under the contract. It is the Commission's understanding that some of this legislation covers contracts involving the sale of farm machinery. However, it would be highly desirable for all provinces to pass legislation requiring this provision for all credit issued in the purchase of farm machinery. This would forcibly draw the farmer's attention to the higher interest rate charged by the farm machinery and finance companies, compared with the F.I.L.A. rate. It would also be important to specify in this legislation that the simple interest rate to be calculated under this legislation should exclude any interest-free period so the rate would not be artificially low. The various farm organizations could do their members a service by drawing to their attention the advantage of F.I.L.A. financing. In any future revisions of the Act, particular attention should be paid to the implications of any change for the level and degree of competition that exist in the farm machinery industry.

It is also recommended that the maximum term for farm-implement lending under F.I.L.A. be lengthened by at least two years. If further control is desired, loans could be classified according to the type of implement financed rather than by the size of the loans. Lenders would, of course, be free to use their judgement to lend for shorter than the maximum periods. In addition, in order to increase the flexibility of farm machinery loans and to increase their attractiveness for intermediate-term use, consideration might be given to a "two-step" interest-rate plan. Under this arrangement the interest rate charged on a loan would automatically be adjusted at the end of three years to the rate indicated by the interest-rate formula at that time. This would mean that the yield on the loan would be updated to current terms and would introduce, with a minimum of administrative complexity, one aspect of a second shorter-term loan from the lender's point of view. Finally, in view of the importance of farm machinery finance, it is recommended that some governmental authority, perhaps the Bank of Canada, should undertake to collect and publish data annually on all significant sources of funds. These data might well include the amount of farm machinery credit extended during the year, the amount outstanding at the end of the year, the proportion of credit extended for new and old machinery, duration of loans made, normal down-payment required and interest rates charged, size of loans granted, and bad debt experience.

Chapter 12

PROFITS

The profits earned by the farm machinery industry may provide an indication of the degree of monopoly existing in the industry. High profits over an extended period would be clear evidence of monopoly pricing and the existence of an effective barrier to the entry of new firms. But low profits for the industry as a whole need not mean an absence of monopoly pricing. If the dominant firms have significant advantages in the form of economies of scale on major products such as tractors and combines, and prices are high enough to permit them to earn monopoly profits on these products, these same prices may permit smaller high-cost firms to survive, thus keeping the industry's average profit low.

High profits for individual firms may have other explanations. For major firms they may be the result of large R&D expenditures which give these firms a continuing lead in the introduction of new products. Smaller firms may earn high profits by specializing in particular product lines and pioneering new developments in these areas. As the industry has become more international in scope, the profit record of major firms has also become dependent on their international strategy in locating production facilities in low-cost countries, and in developing and managing their production and marketing on a worldwide scale. It is also possible for major firms to earn high profits in manufacturing major products but dilute these profits either through heavy investments in distribution assets or by manufacturing other products on much smaller margins. Nevertheless, persistent high profits are evidence of monopoly. This chapter will first consider the evidence on the profits earned in the industry, and then assess the explanations of this evidence.

In considering the profits earned by farm machinery manufacturers it is important to go beyond Canadian borders and consider profits earned in North America as a whole, and to some degree the profits earned on the worldwide operations of the major companies. About two-thirds of the farm machinery manufactured in Canada is exported. And about 70 per cent of the farm machinery purchased by Canadian farmers is imported, mainly from the United States. Increasingly, too, as is pointed out in Chapter 14, world trade in farm machinery is coming under the dominance of a few major international companies. And as was

demonstrated in the Commission's *Special Report on Prices of Tractors and Combines in Canada and Other Countries,* trade may be regulated so that farmers in Canada do not get the full advantage of low-cost production in other countries. Thus the prices paid by Canadian farmers are highly dependent on the costs and profits of the industry in the United States as well as Canada and on the way the industry conducts its worldwide operations.

The profits earned by this industry in Canada must be viewed as one segment of the profits earned in a continent-wide and to an important degree a worldwide manufacturing and marketing activity. Taken by themselves, these Canadian profits need careful interpretation. Most of the exports on which manufacturing profits are so heavily dependent go to another branch or subsidiary of the same international company. For this reason the prices at which this transfer is made are to some degree arbitrary. Similarly, all the major firms selling farm machinery in Canada import all or most of the machines they sell from the United States or Western Europe. Again, the price they pay for these machines is a transfer price–a price at which the machine is transferred from one division to another division of the same international corporation. These transfer prices, and to an important degree the profits earned in Canada by these firms, are arbitrary. As will be shown later, modest variations in these transfer prices can cause large variations in the profits of the Canadian subsidiary. There are, of course, independent firms that manufacture and sell primarily in Canada. But the Canadian profit picture is dominated by the major international firms.

Evidence on the worldwide profits of the major farm machinery firms will be examined first. Then the data on profits earned by the industry in Canada will be considered.

Worldwide Profits of Major Farm Machinery Manufacturers

This appraisal of the worldwide profits of major international companies has been based on published information for six companies active in the Canadian market–namely, Deere & Company, Massey-Ferguson Limited, International Harvester Company, J. I. Case Company, Allis-Chalmers Manufacturing Company, and the White Motor Corporation. All of these companies are full-line companies, with 25 per cent or more of their worldwide sales consisting of farm machinery. All perform the wholesale function as well as manufacturing most of the products they sell, selling directly to franchised dealers who perform the retail function. All but Case and Allis-Chalmers have a manufacturing operation in Canada. Five of the companies are American-owned with headquarters in the United States. The sixth, Massey-Ferguson Limited, is Canadian-owned with worldwide headquarters in Toronto. The brand names of the machinery sold by these firms are well known to generations of Canadian farmers.

Two other large companies with extensive farm machinery operations, the tractor division of the Ford Motor Company and the New Holland Division of the

Sperry Rand Corporation, were excluded from this survey because their farm machinery activities, though significant in absolute size, represented only a minor part (about 3 per cent and 12 per cent, respectively) of total company sales.

The six companies surveyed vary markedly both in respect to the share of farm machinery in their total sales and in the importance of their North American sales and manufacturing operation in the company's worldwide operation. As Table 12.1 shows, Deere, Massey-Ferguson, and Case are basically farm machinery companies with 55 per cent or more of their total sales provided by farm machinery

TABLE 12.1–WORLDWIDE SALES OF ALL PRODUCTS, FARM MACHINERY SALES, AND NORTH AMERICAN SALES, SIX MAJOR COMPANIES, 1967

	Worldwide Sales		Farm Machinery Sales	North American Sales of All Products
	All Products	Farm Machinery		
	(Millions of U.S. dollars)		(As a percentage of total company sales)	
Deere	$1,086	$931	86	86
Massey-Ferguson	846	659	78	41
Case	345	190	55	89
International Harvester	2,542	801	32	82
Allis-Chalmers	859	231	27	88
White Motor	770	196	25	98

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Tables 2.1 and 2.3.

and a substantial part of their remaining sales made up of light industrial equipment, a product line that is broadly similar to farm machinery. International Harvester, Allis-Chalmers, and White Motor each have an important farm machinery operation but it constitutes only from 25 to 31 per cent of their total sales. International Harvester has a major part of its manufacturing and sales in trucks and heavy construction equipment. White Motor is also a major producer of trucks, and Allis-Chalmers has a widely diversified manufacturing operation which includes mining, construction, electrical, and other machinery. An approximate picture of the six companies' distribution of sales by product line is given in Table 12.2.

With the exception of Massey-Ferguson, all six firms have 80 per cent or more of their worldwide sales in North America. Massey-Ferguson, in 1967, had only 41 per cent of its sales on this continent, 31 per cent in the United States and 10 per cent in Canada. In 1969 this had fallen further to 38 per cent in North America and 8 per cent in Canada. Measured by the book value of net fixed assets, only three firms–Massey-Ferguson, Deere, and International Harvester–have about 20 per cent or more of their manufacturing facilities outside North America. For Deere and International Harvester the share for the most recent year is 21 and 19 per cent

respectively, and for Massey-Ferguson 53 per cent. This latter figure probably understates Massey-Ferguson's activities outside North America, since in 1965 it had 74 per cent of its total employment and 61 per cent of its factory square footage outside this continent. For both Case and Allis-Chalmers, sales outside North America have suffered a relative decline in recent years, Case from 15 per cent of total sales in 1963 to 11 per cent in 1967, and Allis-Chalmers from 20 per cent in 1960 to 12 per cent in 1967.

TABLE 12.2–SALES PERCENTAGES FOR MAJOR PRODUCT LINES, SIX MAJOR FARM MACHINERY COMPANIES, 1967

	Deere	Massey-Ferguson	Case	International Harvester	Allis-Chalmers	White Motor
Farm machinery	86	78[1]	55	32[2]	27[2]	25
Trucks	–	–	–	44	–	44
Light industrial, lawn and garden	14	12	45	5[2]	6[2]	–
Heavy earthmoving machinery	–	–	–	13	24[3]	–
Production equipment		–	–	–	27[4]	11[5]
Electrical utilities equipment	–	–	–	–	16	–
Engines	–	10	–	–	–	–
Miscellaneous	–	–	–	6	–	20
	100	100	100	100	100	100

[1] Massey-Ferguson's parts sales have been allocated to farm machinery, industrial equipment, and engines. This procedure has not been followed with respect to White Motor because White Motor's parts and service is believed to include the operation of truck service centres.

[2] The division between farm machinery and light industrial, lawn and garden equipment was estimated using Deere's ratio.

[3] Includes iron-ore pelletizing and other processing equipment.

[4] Includes such diverse items as pumps, compressors, motors, paper-machines, small generators, switchgear, lift-trucks, wind-tunnels, and water and air pollution control equipment.

[5] Includes compressors, engines, and fork-lift trucks.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 2.2.

An analysis of the asset holdings and sales of the three major international firms–Massey-Ferguson, International Harvester, and Deere–shows a significant upward trend in the share of Massey-Ferguson's and Deere's total assets located outside North America, and a rather mixed pattern for sales, with Deere's sales outside North America increasing in importance and Massey-Ferguson's and International's declining somewhat over the period. The decline in Massey-Ferguson's sales position outside North America undoubtedly reflects its success in increasing its penetration of the United States market. Sales in the United States, for example, increased from 24 per cent of Massey-Ferguson's total sales in 1962 to 30 per cent in 1969. Some details on these changes are given in Table 12.3.

TABLE 12.3–PERCENTAGE OF COMPANY SALES AND ASSETS OUTSIDE NORTH AMERICA, THREE MAJOR FARM MACHINERY COMPANIES, SELECTED YEARS, 1957-69

	Deere	Massey-Ferguson	International Harvester
		Sales of All Products	
1957	12	66	23
1960	13	58	21
1963	11	65	20
1967	14	59	18
1968	17	62	19
1969	18	62	19
		Total Assets	
1957	8	41(1958)	17[1]
1960	11	48	17
1963	15	55	19
1967	21	51	20
1968	19	51	19
1969	21	53	19

[1]Data for International Harvester are net assets in all years, the equivalent of the company's equity in non-North American subsidiaries; percentage is related to total net assets.

Source: From D. Martinusen and B.P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 2.5, and Commission analysis of later *Annual Reports* of companies.

Only fragmentary data are available with respect to the relative profitability of different product lines and regions. This makes it difficult to draw firm conclusions with respect to the profitability of the production and sale of farm machinery in North America. The White Motor Corporation, a newcomer to farm machinery and a company whose sales are almost entirely in North America, reported that "profit margins on sales of farm equipment are generally higher than on sales of trucks and industrial equipment".[1] International Harvester has published some information on earnings by region. The results for the period 1962 to 1967 were as follows:

	Annual Sales Millions of U.S. Dollars	Net Income as Percentage of Sales	Net Income as Percentage of Net Assets
		(Averages for 1962-67)	
North America	$1,800	4.4	9.1
Europe and Africa	247	1.5	3.1
Latin America	68	(0.4)	(0.8)
Pacific area	130	4.1	8.9
World total	2,244	3.9	8.2

[1]Company *Prospectus*, March 12, 1968, p. 7.

These data indicate that earnings in North America were significantly higher than in the rest of the world. Deere has also reported substantial losses in its business outside North America since its decision to enter this market in a substantial way as a manufacturer as well as a seller. In contrast, Massey-Ferguson apparently had net income after tax as percentage of sales in 1966 of about 5.7 per cent outside North America, compared with only 3.9 per cent in North America.[2] This difference between the position of Deere and Massey-Ferguson is consistent with the fact that Massey-Ferguson is already well established outside North America and is trying to increase its share of the United States market whereas the reverse is true of Deere. Both companies may be incurring extra sales' costs and selling at more favourable prices in the markets they are trying to penetrate.

Since profits are often assessed in relation to assets, it is also useful to examine available data with respect to capital expenditures and asset levels. The various indicators in Table 12.4 provide some measure of the level of capital expenditures and the fixed-asset position of the six firms. The data suggest that Deere and Massey-Ferguson have had the highest capital expenditure program in

TABLE 12.4–INDICATORS OF INVESTMENT IN FIXED ASSETS AND CAPITAL EXPENDITURES, SIX MAJOR FARM MACHINERY COMPANIES, VARIOUS PERIODS, 1957-67

	Net Fixed Assets per Employee, Average 1962-67	Capital Expenditures as Percentage of Sales		Capital Expenditures 1963-67 as Percentage of Net Fixed Assets December, 1967	Ratio of Net Sales to Net Fixed Assets, 1963-67
		1957-67	1963-67		
	($'000 U.S.)				
Deere	4.8	5.3	6.0	105	4.6
Massey-Ferguson	3.2	5.5	5.4	107	5.0
International Harvester	3.9	3.9	4.0	80	5.0
Case	4.3	3.3	5.3	91	5.0
Allis-Chalmers	3.6	2.0	2.7	90	4.5
White Motor	3.0[1]	–	1.6	87	15.0

[1] 1967 only.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Tables 4.6 to 4.9.

relation to sales over the past decade, with average expenditures of 5.3 and 5.5 per cent of sales. Case has had a similar expenditure level in the later five-year period (1963-67). As a result, Deere and Massey-Ferguson currently have the "newest" fixed-asset structure, judged by the ratio of their capital spending in the last five

[2] Data are approximate since they appear in chart form only in E. P. Neufeld, *A Global Corporation*, Toronto, 1969, pp. 166-9.

years to their net fixed assets at the end of 1967. In relation to sales, White Motor and Allis-Chalmers had the lowest level of capital expenditures. Five of the six companies have ratios of sales to net fixed assets within the range of 4.5 and 5.0. The exception is White Motor with the very different ratio of 15.0. This undoubtedly reflects its acquisition of assets at very favourable prices.

A comparison of operating profit ratios (as a percentage of sales) for these six companies over the postwar period shows a marked variation in the profitability of different firms and a general decline in profit ratios. As Table 12.5 shows, for three companies, Massey-Ferguson, Case, and Allis-Chalmers, ratios for the period from 1957-67 varied from 37 to 63 per cent of those achieved in the preceding decade. Deere and International Harvester showed much smaller declines. Deere's operating profit ratio is very much the highest, more than twice as high as for most other firms.

TABLE 12.5–OPERATING PROFITS AS PERCENTAGE OF NET SALES, SIX MAJOR FARM MACHINERY COMPANIES, 1947-56, 1957-67, 1963-67, 1968, and 1969

	Deere	Massey-Ferguson	Case	International Harvester	Allis-Chalmers	White Motor
1947-56	17.4	10.7	10.9	8.8	10.2	n.a.
1957-67	14.8	6.7	4.0	8.2	4.7	n.a.
1963-67	15.3	7.4	7.5	8.2	4.0	7.1
1968	10.1	6.5	6.1	6.1	(10.8)	6.1
1969	10.3	6.1	6.1	5.4	n.a.	4.7

Source: *Annual Reports* of companies and *Moody's Industrial Manual.*

Deere's higher operating-profit ratio reflects almost entirely a lower ratio of cost of goods sold to net sales. Deere's ratio for the period 1957-67 averaged 73.5 per cent, considerably lower than the comparable ratio for any of the other five companies (see Table 12.6). Four of the remaining companies had a ratio within the narrow range of 80 and 81 per cent, and the other company, Allis-Chalmers, had a ratio of 83.6 per cent. Massey-Ferguson's ratio of 80.9 for the period, as a whole, conceals a downward trend from around 88 in 1957 and 83 in 1958 to about 77 per cent in recent years. Deere is the only one of the six companies whose sales not only are predominantly farm machinery, but also are mainly in Canada and the United States. Moreover, as will be elaborated later, Deere's profit ratio for the more recent period was depressed by losses caused by its efforts to get established in European and other markets. It has been estimated that its operating profit ratio might have been 15.5 per cent instead of 14.8 in the 1957-67 period if these losses had been avoided. In terms of the importance of farm machinery sales to total sales and the extent of its sales in the North American market, Case comes closer to Deere than any other company. However, Case with its much smaller volume in farm machinery–around 20 per cent of Deere's–had an operating profit for the period of only 4 per cent. This low figure was heavily affected by the large losses incurred in 1960 and 1961. For the more recent period, from 1963 to 1967, Case's ratio was about 7.5 per cent compared with 15.3 per cent for Deere.

TABLE 12.6 COSTS AND PROFITS OF FARM MACHINERY COMPANIES PER $100 SALES

(Averages for 1957-67)

	Deere	Massey-Ferguson	Case	International Harvester	Allis-Chalmers	White Motor[1]
Net sales	100.00	100.00	100.00	100.00	100.00	100.00
Cost of goods sold	73.50	80.90	80.40	80.60	83.60	80.80
Gross profits	26.50	19.10	19.60	19.40	16.40	19.20
Selling, general and admin. expenses	11.70	12.40	15.60	11.20	11.70	12.10
Operating profits	14.80	6.70	4.00	8.20	4.70	7.10
Interest and other expenses (net)[2]	.40	1.20	3.30	.90	.40	.70
Profits before tax	14.40	5.50	.70	7.30	4.30	6.40
Income taxes	7.70	1.80	2.60	3.50	2.00	2.90
Tax rate (income taxes as percentage of profits before tax)	54%	33%	165%[4]	48%	46%	45%
Net income (after tax)	6.70	3.70	(.50)	3.80	2.30	3.50
Shareholders' equity employed per $100 sales[3]	63.00	40.00	45.00	53.00	54.00	25.00
Return on investment (after tax)	10.6%	9.3%	(1.1)%	7.2%	4.3%	13.8%

[1] For the White Motor Corporation the period 1963-67 was used because that company only entered the farm machinery industry, by acquisition, in the period 1960-62.

[2] "Interest and other expenses (net)" is a balancing item and includes interest expense, charges made by finance subsidiaries for financing services, the net profits of finance subsidiaries, and other minor income and expense items.

[3] Average of year-end balances used in computing equity figures.

[4] This high rate reflects the effect of heavy losses midway through the period.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 3.2.

Table 12.6 also gives data on net income after tax as a percentage of sales and as a return on shareholders' investment for the period 1957-67. Here again, in the ratio of net income to sales, Deere shows a much higher return than any of the other five companies. However, White Motor, whose data cover only the higher sales years from 1963-67, earned a higher return than Deere on its equity investment. This partly reflects the fact that White acquired its production assets in the Oliver, Minneapolis-Moline, and Cockshutt companies at below book value. In its annual reports, White reported that Oliver was acquired at about 80 per cent of book value and Minneapolis-Moline at 63 per cent. Shareholders' equity per $100 of sales is only $25 for White, compared with $63 for Deere. Deere's net income ratio is also reduced relative to those of other companies by its higher average tax rate. The tax rates for different companies vary significantly because of the different tax rates levied in different countries, losses recorded by some companies in certain years, and the advantages obtained under special tax incentives.

In interpreting the profit data for farm machinery companies it is important to recognize the rather unusual asset structure of the industry. As described in

Chapter 11, after the postwar backlog of demand had been filled in the early fifties and total sales of farm machinery declined, the North American industry introduced the practice of floor-planning new farm machines in the hands of dealers on an interest-free basis. Later, most companies extended this practice to machines accepted in trade. For all companies, this has resulted in very large additions to accounts receivable.

In addition, in the late fifties most of the major companies introduced finance plans to allow their dealers to finance sales to their farmer customers. To facilitate this increase in credit-granting, all of the six companies under examination set up finance subsidiaries. International Harvester's subsidiary was established in 1949. The rest were set up between 1955 and 1962. Most of the companies sell their dealer floor-planning notes as well as their retail sales contracts to their credit subsidiary. However, both Massey-Ferguson and Deere for the most part keep their dealer accounts receivable in the parent company.

The corporate effect of these activities is shown in Table 12.7 which provide for 1957 and 1967 a combined balance sheet for the six companies, both including and excluding the finance subsidiaries. When the accounts of the finance subsidiaries are consolidated with the accounts of the parent firm, the combined balance sheet shows an increase in accounts receivable to 50 per cent of total assets from 33 per cent a decade earlier. On the liability side there was a substantial but smaller growth in current liabilities as a source of funds. Similar but much smaller changes appear when the balance-sheet totals exclude the finance subsidiaries.

TABLE 12.7–BALANCE SHEET STRUCTURE, 1957 AND 1967, SIX MAJOR FARM MACHINERY FIRMS, INCLUDING AND EXCLUDING FINANCE SUBSIDIARIES

(Percentage of total)

	Including Finance Subsidiaries		Excluding Finance Subsidiaries	
	1957	1967	1957	1967
Assets				
Accounts receivable	33	50	23	27
Inventories	32	26	36	36
Net fixed assets	23	16	26	23
Other	12	8	15	14
Total	100	100	100	100
Liabilities				
Current	26	38	18	26
Long-term debt	15	23	16	15
Equity	59	39	66	59
Total	100	100	100	100

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Tables 4.1, 4.2 and Appendix Tables C.8 and C.9, and Commission estimates.

TABLE 12.8–TEN-YEAR CASH FLOW, MAJOR FARM MACHINERY FIRMS, 1957-67[1] CONSOLIDATED DATA INCLUDING FINANCE SUBSIDIAIRIES

(Expressed as percentages of total sources and uses of funds)

	Deere	Massey-Ferguson	International Harvester	Case	Allis-Chalmers	White Motor[2]	Total	
								($ million)
Sources								
Net income	30.5	24.2	36.6	(3.3)	18.8	31.8	28.3	1,738
Add depreciation	15.4	19.6	28.9	14.9	22.6	8.2	21.1	1,293
Operations	45.9	43.8	65.5	11.5	41.4	40.0	49.4	3,031
Short-term debt addition – net	16.3	20.1	14.8	10.8	28.9	27.2	18.3	1,122
Accounts payable and other current liability increases	13.7	11.5	6.1	40.0	5.9	7.3	10.8	668
Long-term debt and other long-term liability increases	20.0	11.3	13.1	46.7	21.6	24.5	18.2	1,115
Common stock issues – net	4.1	13.3	0.5	(9.1)	2.2	1.0	3.3	201
Total sources	100.0	100.0	100.0	100.0	100.0	100.0	100.0	6,137
Uses								
Accounts receivable increase	45.0	36.3	27.4	68.7	51.2	50.4	39.7	2,449
Inventory increase	12.6	14.7	12.7	17.6	1.9	21.0	12.5	769
Fixed asset additions – net	23.9	31.6	32.1	28.0	27.2	14.7	28.1	1,731
Other asset increases	3.1	4.6	1.1	(0.3)	7.2	0.7	2.8	173
Dividends	11.6	8.8	18.8	2.2	12.5	11.7	13.3	817
Retirement of preferred stock – net	1.9	2.5	3.8	(1.0)	(0.4)	1.6	2.2	87
Charges against retained earnings and capital surplus – net	1.9	1.5	4.1	(15.2)	0.4	(0.1)	1.4	137
Total uses	100.0	100.0	100.0	100.0	100.0	100.0	100.0	6,163
Increase (decrease) in cash and marketable securities – per cent of total sources	(0.6)	0.2	(2.9)	4.2	2.7	2.1	(0.4)	(25)

[1] White Motor and Allis-Chalmers have fiscal years ending December 31; the remaining firms – October 31.
[2] Data for five years ended December 31, 1967, only.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table C.10, and Commission analyses.

A similar picture emerges in Table 12.8, showing the source and use of cash for five of the six major firms over the 1957-67 period. These data, which include consolidated data for the finance subsidiaries, show that 40 per cent of the cash acquired by the five companies during this period was used to finance accounts receivable. Only 28 per cent of total cash was used for additions to fixed assets. In the case of Deere, the share of cash going to finance accounts receivable was even larger, 45 per cent of the total. This undoubtedly reflects Deere's heavy sales concentration in farm machinery and in the North American market coupled with its policy of consignment selling in Canada. The five firms as a group devoted some \$2.5 billion to the finance of accounts receivable over this period.

The preponderance of current as opposed to fixed assets in the balance sheets of the farm machinery companies is evident in Table 12.9. The asset-to-sales ratios of the two companies whose business is most heavily concentrated in farm machinery in the North American market, Deere and Case, are higher than those of

TABLE 12.9–NET INCOME, ASSETS EMPLOYED, RETURN ON INVESTMENT AND RETURN ON TOTAL ASSETS, SIX MAJOR FARM MACHINERY COMPANIES, INCLUDING FINANCE SUBSIDIARIES, EXPRESSED AS PERCENTAGE OF SALES, 1963-67

	Deere	Massey-Ferguson	Case	International Harvester	Allis-Chalmers	White Motor
Net sales	100.0	100.0	100.0	100.0	100.0	100.0
Net income (after tax)	6.5	4.4	3.8	4.0	2.0	3.5
Total assets employed						
Accounts receivable	75.0	50.0	79.0	37.0	48.0	37.0
Inventories	30.0	31.0	31.0	30.0	32.0	29.0
Net fixed assets	22.0	20.0	19.0	19.0	18.0	6.0
Other	6.0	3.0	15.0	11.0	11.0	4.0
Total assets	133.0	104.0	144.0	97.0	109.0	76.0
Shareholders' equity	59.0	40.0	31.0	47.0	47.0	25.0
Return on investment (after tax)	11.0	11.0	12.5	8.6	4.3	13.8
Return on total assets (after tax)	7.7	8.3	6.5	6.9	3.6	7.9

Note: Return on investment is defined as net income after tax as a percentage of shareholders' equity. Return on total assets is defined as net income after tax plus interest paid as a percentage of total assets.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 4.13, and Commission estimates.

any other company, being 133 and 144, respectively. For each \$100 of sales, Deere on the average at its fiscal year-end was holding \$133 in assets, of which \$105 was in the form of accounts receivable or inventories and only \$22 was in the form of fixed assets. Similarly, Case had \$144 in assets for each \$100 of sales with \$110 of these assets being in the form of accounts receivable or inventory and only \$19 in the form of fixed assets. Since the asset data are taken at the date of the company's fiscal year-end–in each case, after the heavy selling season is over–these asset ratios

do not simply reflect a seasonal build-up of inventory in the hands of the company and their dealers in anticipation of the selling season. Indeed, it seems likely that data on a monthly average basis would show an even higher ratio of current to fixed assets.

Because of the comparatively low ratio of fixed to total assets, it is evident that comparatively large differences in profitability at the manufacturing level —such as would arise out of economies of scale—would result in only modest differences in the rate of return on total assets or on shareholders' equity. As demonstrated in Chapter 7, a firm with an annual tractor output of 60,000 or 90,000 units a year would earn a very much higher return on its manufacturing assets than a firm operating at the 20,000-unit level. For tractors, this roughly represents the difference between Deere and Case. Deere also undoubtedly enjoys a much larger volume than Case on combines and many other products, since its total sales of farm machinery are of the order of 4 to 5 times those of Case. Given the large volume of current assets both companies carry, it is clear that Deere's presumed higher profits at the manufacturing level will be very much diluted in its over-all return on investment or on total assets.

Measured by return on investment (net income after tax as a percentage of shareholders' equity) the long-run average profits of the five companies, or their worldwide operations for all products, are not high when compared with other large United States based corporations (White Motor is excluded because of its recent entry to the industry). A recent study of 528 large U.S. corporations shows that about two-thirds earned more than Deere, the most profitable of the five, over the period 1946-65.[3] The comparison is as follows:

Average Return on Investment, 528 Large U.S. Corporations 1946-65		Relative Position of Five Major Farm Machinery Companies' Return on Investment (1946-67)
Rate of return (Per cent)	Percentage of all 528 companies	(R.O.I. shown in parentheses)
Over 20	13	
16 – 20	14	
12 – 16	31	
10 – 12	17	Deere (11.0)
		Massey-Ferguson (10.3)
8 – 10	13	
6 – 8	7	International Harvester (7.6)
		Allis-Chalmers (6.3)
Under 6	5	Case (3.3)
Total	100	

Three of the five firms were in the category occupied by the bottom 12 per cent of the 528 large firms.

[3] J. J. Scanlon, "How Much Should a Corporation Earn? " *Harvard Business Review*, Vol. 45, No. 1, January – February 1967.

The results are somewhat different when the average return on the book value of total assets is used as a criterion. On this basis, in the earlier period from 1946-56, all five of the major firms in the industry earned more than the average

TABLE 12.10–RETURN ON INVESTMENT AND RETURN ON TOTAL ASSETS, SIX MAJOR FARM MACHINERY FIRMS, 1946-67

(Data are after corporate taxes)

	Return on Total Assets			Return on Investment		
	1946-56	1957-67	1963-67	1947-56	1957-67	1963-67
		(Per cent)			(Per cent)	
Deere	7.9	7.4	7.7	11.5	10.6	11.0
Massey-Ferguson	7.4	7.1	8.3	14.5	9.3	11.0
International Harvester	6.4	5.5	6.9	8.2	7.2	8.6
Allis-Chalmers	6.2	3.7	3.6	9.1	4.3	4.3
Case	6.1	1.7	6.5	7.8	(1.1)	12.5
White Motor	n.a.	n.a.	7.9	n.a.	n.a.	13.8

Note: Data for return on investment include finance subsidiaries on a consolidated basis. Data for return on total assets are for parent company assets and earnings with the finance subsidiary included on a net basis. If consolidated data were available it would reduce the returns reported by around one percentage point in the later years.

Return on investment is defined as net income after tax as a percentage of shareholders' equity. Return on total assets is defined as net income after tax, plus interest paid as a percentage of total assets.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Tables 3.4, 3.6, and 4.13, and Commission estimates.

TABLE 12.11–AVERAGE RATES OF RETURN ON TOTAL ASSETS (BOOK VALUES) IN VARIOUS INDUSTRIES IN THE UNITED STATES, 1948-57 and 1958-65

	Rate of Return	
	1948-57	1958-65
	(Per cent)	
Manufacturing	5.0	6.2
Machinery (excluding transportation and electrical)	5.5	6.9
Agricultural machinery	4.6[1]	4.8
Fabricated metal products	5.2	6.3
Transportation equipment (excluding motor vehicles)	4.0	4.7

Note: Estimates for 1948-57 not strictly comparable with those for 1958-65. Stigler excluded income from securities, from income, and the value of securities from assets. Income was adjusted for excessive withdrawals by officers of small companies. No such adjustments were made for the later period, 1958-65.

[1] Stigler's original data included a breakdown for rate of return in agricultural machinery. However, his errata statement did not include this breakdown. The figure shown here for agricultural machinery is a calculation based on the relationship between agricultural machinery and machinery (excluding transportation and electrical) in the original data.

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 7.1.

return to the manufacturing industries studied by George Stigler[4]. A comparison of the earnings of the five firms using these two different concepts is given in Table 12.10. However, data for the agricultural machinery industry as a whole show lower earnings in terms of return on total assets than manufacturing as a whole or the subgroups of machinery and fabricated metal products (see Table 12.11).

Profits Earned by the Farm Machinery Industry in Canada

In order to assess the profits earned by the farm machinery companies operating in Canada, the Commission sent out a financial questionnaire which was completed by all the larger firms and a sample of smaller ones. It was hoped to obtain data for the period 1957-66 but changes in ownership and the disappearance of records made it necessary to limit published totals to the period 1960-66. Even then, not all companies could provide data for the earlier years of this period. Data on a more limited basis were obtained for the years 1967-69.

For purposes of analysis the various companies were classified into four groups. Group I consists of the four largest companies that have a manufacturing operation in Canada. These firms also carry out their own wholesale distribution of machines and parts. Group II includes six larger firms that perform their own wholesaling in Canada but do not manufacture in Canada. Group III consists of one firm, the Versatile Manufacturing Company. It is shown separately because published data on its operations were available and it has enjoyed unusual success in recent years. Group IV consists of six relatively small Canadian-owned manufacturers and distributors of farm machinery. Some additional information on the product lines, wholesale distribution network, and manufacturing facilities of these various firms is provided in a series of statistical tables appended to this chapter (see Tables 12.24, 12.25, 12.26 and 12.27).[5]

The 17 farm machinery firms surveyed accounted in 1966 for 86 per cent of all the farm machinery and repair parts sold in Canada, 85 per cent of all farm machinery manufactured in Canada, 82 per cent of the value added in such manufacturing, and 93 per cent of Canadian exports of farm machinery and repair parts. The data cover light industrial equipment as well as the farm machinery activities of these companies, but since the former is only about 10 per cent of the total, the overall results mainly reflect farm machinery operations.

Within the above percentages of total reported activities, the four firms making up Group I and the six firms constituting Group II are of overwhelming importance, as shown in the following tabulation. The four Group I companies accounted for roughly two-thirds of domestic sales and imports and for 96 per cent of exports. Groups I and II combined accounted for over 90 per cent of all three categories.

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[4]G. J. Stigler's data are for the period 1947-56. Return on total assets was defined as the ratio of net income plus interest to total assets less investments in other companies. See *Capital and Rates of Return in Manufacturing Industries,* National Bureau of Economics Research (Princeton: Princeton University Press, New Jersey, 1963).

[5]Additional information on the results of the financial questionnaire will be found in D. Martinusen and B. P. Barry, *op. cit.*, Ch. 5, and Appendix A.

Breakdown by Company Groups, as Reported to Commission, of Canadian Domestic Sales, Exports, and Imports of Farm Machinery End Items and Repair Parts, 1966

(Percentage of total)

	Domestic Sales	Exports	Imports
Group I	68	96	65
Group II	26	–	35
Groups III and IV	6	4	–
	100	100	100

The data provided by the Commission's financial questionnaire also underline the degree to which Canada's exports and imports of farm machinery reflect a movement of goods from one branch or subsidiary of a company to another branch or subsidiary of the same company. Over 90 per cent of Canada's exports and imports in this industry fall into this category.

In setting out to analyze the profit situation in the Canadian industry, the Commission first had to choose an appropriate way to measure profit. One possibility was to assess the rates of return on investment, i.e. the net after-tax income as a percentage of shareholders' equity. But this would have no very clear meaning for many companies in Canada, because they operate as wholly-owned subsidiaries of large international firms. Another possibility was to measure net income as a percentage of sales. Such information is available, but it has a different meaning for firms that both manufacture and sell in Canada than for those that only sell. Thus the Commission concluded that the most useful measure of profit would be the return on total assets before tax. For all firms, assets consist mainly of accounts receivable from dealers and farmers, and inventories of machinery and parts at branch or central warehouses. For Group II companies, fixed assets now make up less than 4 per cent of total assets.

For all firms in Groups I and II, the large volume of exports or imports that occur between parent and subsidiary at what are necessarily transfer prices introduces a large element of arbitrariness into the profits that were reported. The reported profits are considered first. The extent to which they may be affected by transfer prices will then be examined.

The net returns on total assets reported by these four groups of companies for the period 1960-66 are presented below. The net return, which consists of net income before tax plus interest, is that earned on the companies' farm machinery and light industrial equipment activities. Data for the various groups of companies are provided in Table 12.12. Because the measure used here differs from that used earlier for the major international companies, a comparable measure for these companies covering their worldwide activities, and for various U.S. manufacturing industries is provided in Table 12.13.

TABLE 12.12–RETURN ON ASSETS OF CANADIAN FARM MACHINERY FIRMS BY GROUP, 1960-66 (GROUP III, 1963-68)

(Before tax basis)

	Group I	Group II	Group III	Group IV		
	(3 of 4 companies)	(5 of 6 companies)	(1 company)	(3 companies)	(5 companies)	(6 companies)
1960	5.0	(3.1)	n.a.	3.4		
1961	5.8	(1.7)	n.a.	11.8	9.9	
1962	8.8	7.6	n.a.	40.9	36.4	
1963	11.6	11.9	40.9	37.9	34.9	28.1
1964	10.4	11.0	44.6	24.3	23.1	17.6
1965	9.0	9.3	38.7	30.1	33.4	25.7
1966	10.2	15.9	38.7	23.6	23.2	21.5
Averages[1]	8.9	8.7	40.1	25.2	26.6	22.9
1967			28.4			
1968			16.2			
Average 1963-68[1]			28.4			

n.a. – not available.

Note: *Return on Assets:* Profit *before* tax plus interest payments as a percentage of total assets.

[1] Average from Total Return to Total of Annual Assets over period.

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 6.1.

TABLE 12.13–COMPARATIVE PROFITABILITY DATA: RETURN ON ASSETS AND RETURN ON INVESTMENT OF FIVE MAJOR FARM MACHINERY FIRMS AND SELECTED U.S. MANUFACTURING INDUSTRIES, AVERAGES FOR 1957-67

	Return on Assets	Return on Investment
Major Farm Machinery Firms[1]		
Deere & Company	14.2	10.6
Massey-Ferguson Limited	9.1	9.3
J. I. Case Company	2.8	(1.1)
International Harvester Company	9.9	7.2
Allis-Chalmers Manufacturing Company	6.0	4.3
Average	9.7	7.3
U.S. Manufacturing Industries		
Fabricated metal products except machinery and transportation equipment	10.4[2]	8.0[3]
Machinery, except electrical and transportation equipment	12.2[2]	9.1[3]
Transportation equipment except motor vehicles	9.0[2]	8.7[3]
Motor vehicles and equipment	17.7[2]	13.3[3]
Total manufacturing	9.8[2]	8.2[3]

Note: *Return on Assets:* Profit before tax plus interest expense as a percentage of total assets.
Return on Investment: Net income (profit after tax) as a percentage of shareholders' equity.
[1] The ratios were computed for parent companies only because data on interest expense for finance subsidiaries for several companies were not available.
[2] Ten-year average, 1957-66.
[3] Nine-year average, 1957-66, excluding 1963.
Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 6.2.

For the period 1960-66, Group I and Group II companies earned a return on assets of 8.9 and 8.7 per cent, respectively. Profits were comparatively low during the early part of this period but increased appreciably with the higher sales levels of the mid-sixties. In almost all years the profits reported by the smaller companies in Group III and Group IV were very much larger than those earned by the major companies. The return on assets earned by Group I and II companies does not differ significantly from that earned by five major international firms over the slightly longer period from 1957-67 (see Table 12.13). It was very much lower than the return on assets of 17.7 per cent earned by the motor vehicle industry in the United States during this period. Thus, judged by return on assets, the profits earned in Canada by the farm machinery companies that account for the major part of Canadian sales must be considered moderate. Additional information on the asset structure and earnings of the firms in each group is given in the statistical data appended to this chapter (see Tables 12.28, 12.29, 12.30, and 12.31).

A summary view of the relative importance of various assets in relation to sales for each of the four groups is provided by Table 12.14. The result is similar to that presented earlier for the six international companies. In relation to sales, each group has large holdings of distribution assets and comparatively small fixed assets.

TABLE 12.14–ASSETS EMPLOYED PER $100 SALES, GROUPS OF CANADIAN COMPANIES, 1960-66 AVERAGES

	Group I (Three Firms)[1]	Group II (Five Firms)	Group III (One Firm)	Group IV (Three Firms)
Net sales	100.0	100.0	100.0	100.0
Assets employed				
Distribution assets				
Wholesale notes receivable	29.3	33.0	52.5	10.9
Finished goods inventories	22.0	25.6	–	17.8
Total distribution assets	51.3	58.6	52.5	28.7
Retail notes receivable	21.7	24.8	–	–
Factory assets				
Raw materials inventories	2.8	–	21.1	9.0
Work-in-process inventories	8.5	–		1.8
Net fixed assets	15.7	4.7	12.4	11.9
Total factory assets	27.0	4.7	33.5	22.7
Total assets	100.0	88.1	86.0	51.4

[1] Excludes White Motor group; data not available for earlier part of period.

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table D.5.

The very much higher return on total assets earned by Versatile–from two to three times as high as the companies in Groups I and II–reflects lower costs of both manufacturing and distribution. The firm's lower manufacturing costs partly reflect the lower wage costs of the Winnipeg area. It has been estimated by the Commission's staff that wage rates, including fringe benefits, paid by farm machinery manufacturers in the Winnipeg area are about 57 per cent of those in Southern Ontario and about 50 per cent of those prevailing in Moline.[6] The firm has also reduced its manufacturing costs by concentrating on a limited number and sizes of products and obtaining substantial volume in these products. Its products are designed specifically for the Prairie grain region of Canada and the United States. This economizes on cost as compared with a product designed to meet a much wider range of conditions. Finally, Versatile operates with a much lower level of manufacturing overhead. Much of the design of new products and many of the management functions are carried out by the two chief owners and founders of the company.

Versatile has also saved on distribution costs by, to some degree, substituting lower prices for selling costs. It has no branch-house distribution

[6] N. B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table C.3A.

system in Canada and instead ships parts and machines directly from its factory. By offering its dealers a larger discount, it has avoided some of the floor-planning costs of the other companies. Its ratio of sales to total assets has been significantly higher than those of the firms in Group I. Versatile's sales-to-asset ratio has also been slightly higher than the corresponding ratio for firms in Group II, even though these latter firms have no manufacturing assets in Canada.

The difference between Versatile and the older established firms can be highlighted by a comparison of Versatile's costs and profits with those of Deere, the most profitable of the major firms. Such a comparison is given in Table 12.15 for the years 1965-67 and 1967-69. For the industry as a whole the former period was much more profitable than the latter. These data show that although Versatile is a much smaller company and sells at lower prices, its ratio of cost of goods sold to net sales in the earlier period was significantly lower than Deere's but in the later period it had become moderately higher. Versatile's prices are reported to be from 20 to 30 per cent lower than those of other major firms. Versatile's selling, general, and administrative expenses – at 4 per cent of sales, compared with around 11 per cent for Deere–are also very much lower. The company's operating profit as a percentage of sales and net assets is also significantly higher than that of Deere for both periods.

TABLE 12.15–GROSS AND OPERATING PROFITS AS A PERCENTAGE OF SALES, AND OPERATING PROFITS AS A PERCENTAGE OF TOTAL ASSETS,[1] DEERE AND VERSATILE, 1965-67 AND 1967-69

	Deere		Versatile	
	1965-67	1967-69	1965-67	1967-69[2]
Cost of goods sold as percentage of sales	73.8	77.2	69.2	80.0
Gross profit as percentage of sales	26.2	22.8	30.8	20.0
Selling, general and administrative expenses as percentage of sales	10.9	11.4	4.1	4.2
Operating profit as percentage of sales	15.4	11.4	26.7	15.8
Operating profit as percentage of assets	11.1	7.3	32.2	17.2

[1] Total Assets includes the assets of the finance subsidiary for Deere as income statements include finance subsidiary.

[2] Versatile figures for 1969 are for a 14-month period because of a change in its fiscal year-end.

Source: *Annual Reports* of companies.

While the returns on total assets earned by the firms in Groups I and II do not differ appreciably from those reported for this same period by the six major international companies examined above, the profits reported in Canada are clearly much more arbitrary in nature. All the companies in Group I export a major part of what they manufacture to the United States or other affiliates of their parent company. In addition, they import much of what they sell in Canada from a parent or foreign subsidiary. Companies in Group II

import almost all the products they sell in Canada from parent or affiliated companies in the United States or other countries. None of these transactions are in any sense carried out at arm's length. The prices involved are prices at which goods are being transferred from one division of the parent company to another division. As such, they inevitably have a somewhat arbitrary character.

These transfer prices were found to vary from company to company. In 1966 import prices ranged between 60 and 63 per cent of suggested retail price. Export prices ranged from 60 to 66 per cent of suggested retail price. Group I companies reported profits before tax of $34.7 million in 1966. If all four companies had used the least favourable of these transfer prices the highest transfer prices on imports, and the lowest on exports it would have resulted in a profit before tax of only $24.6 million. With the most favourable transfer prices, the profit before tax would have been $46.9 million. Thus no very great precision can be attached to any estimate of profits earned in Canada. It is worth noting however that the transfer prices employed by the companies in Group I do not consistently favour either one country or the other in terms of the amount of profit accruing to a given country. The data do not suggest any deliberate attempt to manipulate the location of profits by country in order to secure a tax advantage.

The profits earned by an international company selling farm machinery in Canada include profits earned at the manufacturing level in the country from which the machinery is imported as well as the profit earned in Canada. On the other hand, the profits reported by companies that manufacture in Canada include profits earned at the manufacturing level on machinery and parts sold in other countries. Both groups of companies earn a profit at the wholesale level on the large distribution assets carried by this industry. Thus the profits earned on sales in Canada can vary substantially from one company to another, depending on how much of the product it sells is supplied from plants in Canada compared with plants in other countries, and on how much of its manufacturing output in Canada is sold for export. An illustration of the way in which companies earning the same global profit can have different proportions of this profit recorded in Canada is given in Table 12.32 at the end of this chapter.

To get a picture of the total profits earned by the international farm machinery companies on their sales to Canadian farmers, the Commission asked the companies to report profits they earned outside of Canada on their sales in Canada. Initially, many of the companies questioned not only the Commission's purpose but also its right to obtain information on profits earned outside of Canada. In the final analysis nearly all of them agreed to provide the Commission with the data requested. Two companies, however, Ford and International Harvester, remained holdouts to the end, refusing to provide the Commission with the data requested. To complete its picture, the Commission

prepared estimates of the profits earned outside the country by these firms and submitted them to the companies for comment and adjustment. In the end, each agreed that the estimates prepared were reasonable.

The results of this analysis are presented in Table 12.16. For six of the major companies in Groups I and II, it provides an estimate for one year, 1966, of profits earned on a worldwide basis from their sales of farm machinery in Canada. The table divides the reported sales and the costs and profits associated with them into two major groups–arm's length sales (sales to dealers in Canada or exported to non-affiliated companies), and those made to affiliated companies in other countries, mainly the United States. Domestic sales in Canada comprise goods manufactured in Canada, shown in column 1 at their manufacturing cost ($74.9 million) and imported wholegoods and repair parts, also shown in column 1 at their transfer price to the Canadian affiliate ($173.3 million). Net sales in Canada by these six companies in 1966 amounted to $310.1 million and against this they reported a gross profit of $61.9 million. After deducting selling costs, and general and administrative expenses, their reported operating profit was $25.2 million. The companies also reported profits earned on their export sales, giving a total gross profit against all sales of $82 million and an operating profit of $44.8 million (shown in column 4).

However, these companies also earned a profit at the manufacturing level on the finished machines and parts that were imported from affiliated firms in other countries. This gross profit is shown under columns 1 and 5 in row 8 in the amount of $28.2 million. Since it costs little or nothing to transfer goods from a branch of the parent company in one country to an affiliated branch in another, these gross profits are also taken as a measure of operating profits net of selling, general and administrative expenses. Thus the total operating profit earned by these international farm machinery companies on a worldwide basis as a result of their sales in Canada amounted in 1966 to $53.8 million, compared with the $25.2 million reported as earned in Canada. The inclusion of profits earned outside Canada makes the profit earned on Canadian sales twice as large and increases it from 8.1 per cent of domestic sales in Canada to 17.3 per cent.

A comparison of this total with the data presented in Table 12.9 for six major international companies (not identical with the six above) indicates that profits on domestic Canadian sales were significantly higher than those earned by the six companies on a worldwide basis on all products in the period 1963-67. However, it must be noted that 1966 profits in Canada were higher than in any other year in the period 1963-67. Since no information is available on the assets used to support these sales, it is not possible to estimate a return to total assets for domestic Canadian sales. A rough rule-of-thumb is that farm machinery companies have about the equivalent of one

TABLE 12.16–ESTIMATED WORLDWIDE PROFITS BEFORE TAXES AND INTEREST ON CANADIAN DOMESTIC SALES OF FARM MACHINERY, 1966

(Data relate to operations of six Canadian Group I and II companies and are expressed in millions of Canadian dollars)

	Arm's Length Sales		Sales to Affiliates		Foreign Affiliates' Sales to Canadian Companies		
	Domestic	Export	(Exports)	Total Sales	Wholegoods and Finished Parts	Materials and Components for Use in Manufacturing in Canada	
	(1)	(2)	(3)	(4)	(5)	(6)	
1. Net sales	310.1	3.4	167.0	480.5		14.5	
2. Imported wholegoods and finished parts for sale	(173.3)			(173.3)	173.3	14.5	Exports to Canadian affiliated companies
3. Manufactured wholegoods and parts	(74.9)	(2.6)	(147.7)	(225.2)	(145.1)	(13.2)	Cost of manufacturing above exports
4. Total cost of goods sold	(248.2)	(2.6)	(147.7)	(398.5)			
5. Gross profit	61.9	0.8	19.3	82.0			
6. Total selling, general and administrative expenses	(36.7)	(0.5)		(37.2)			
7. Operating profit	25.2	0.3	19.3	44.8			
WITHIN CANADA							
OUTSIDE CANADA							
8. Add gross profit earned by foreign affiliates on sales of wholegoods to Canadian companies[1]	28.2				28.2		Gross profit on sales of wholegoods and finished parts
9. Add profits earned by foreign affiliates on sales of components to Canadian companies[2] (included in costs shown in line 3 above)	0.4	0.1	0.8			1.3	Gross profit on sales of components
10. Estimated global operating profits on Canadian sales	53.8	0.4	20.1				
11.	54.2						

[1] Must be earned on domestic sales of wholegoods and finished parts for sale only.
[2] Must be allocated to manufactured output, allocation made pro-rata to manufacturing costs shown.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, **Study No. 11 (Ottawa: Information Canada, 1970), Table 6.3 and Commission analysis.**

year's sales in the form of assets. This would suggest that the return to total assets before tax would be about the same percentage as the return to sales, namely 17.3 per cent. The year 1966 was clearly a very profitable year for farm machinery companies selling in Canada.

Table 12.16 also shows the profits earned on export sales by the farm machinery companies operating in Canada. Export sales to affiliated companies, shown in column 3, amounted to $167 million in 1966 and on these sales the companies reported gross profit of $19.3 million. This can also be taken as a measure of the operating profit, since it can be assumed that there is no cost involved in selling to an associated company. The international companies involved would also earn a distribution profit on these goods before they were finally sold through their dealer organization in the foreign country to the farmer. Thus the operating profit in Canada, amounting to 11.6 per cent of the value of export sales, cannot be compared directly with the operating profit earned on domestic sales in Canada. Similarly, the total operating profit reported to the Canadian tax authorities, $44.8 million (see column 4)–since it is a compound of profits earned at the manufacturing level on export sales, profits earned at the distribution level on goods manufactured in other countries, and some profits earned at both the manufacturing and distribution level in Canada–has no very clear meaning interpreted as a ratio to sales.

The data in Table 12.16 underline the difficulty of interpreting the profits reported in a single country such as Canada by an international farm machinery company that imports and exports on a substantial scale and manufactures its machinery in many different countries. Within fairly broad limits, these companies can shift profits from one country to another by the transfer prices they charge when imports or exports move between different branches of the same company. And if corporate tax rates vary from one country to another, they will have an incentive to show more of their profit in the country with the lowest tax rate. It is worth noting that the total value of imports by the companies covered in Table 12.16, amounting in 1966 to $173.3 million of wholegoods and finished parts and $14.5 million of component parts, was only moderately higher than the value of their exports to affiliated companies, $167 million. Yet the profits earned at the manufacturing level on imports were $28.2 million, 15 per cent, compared with just $19.3 million, 11.6 per cent, on exports. Some of this difference in profitability may reflect the relative importance of the companies involved and the difference in the transfer-price ratios used by these different companies.

The Commission also collected data on profits for different categories of sales. One such breakdown, a division between wholegoods and repair parts, is shown in Table 12.17. It indicates that the gross profit margin is 30.8 per cent on repair parts, compared with 18.2 per cent on wholegoods. The *net* profit margin is 20.3 per cent on repair parts, compared with 5.8 per cent on wholegoods. The higher profit margin on repair parts could be expected, since the companies undoubtedly regard this as a captive market and feel free to price at a higher level

without any risk of losing business. It is true that the companies carry a large parts inventory in relation to sales. Massey-Ferguson reported that their North American parts inventory at the end of the 1966 fiscal year was 102 per cent of their annual sales of parts. On the other hand, parts are not sold on an interest-free floor-planning arrangement or provided to the farmer on credit. Thus the company does not have nearly as large a volume of accounts receivable from dealers and farmers arising out of parts sales as is true for wholegoods. On balance, it does not appear that the investment held against these two types of sales should differ appreciably. The data in Table 12.14 show that the ratio of investment assets to sales is 100 for Group I companies and 88 for Group II companies. The latter companies would also hold manufacturing assets in the United States and other countries against their sales in Canada. If a one-to-one ratio of assets to sales in each part of the business is taken as a norm, then the percentages given in Table 12.17 can also be viewed as measuring the return on total assets.

Nevertheless, some caution is needed in interpreting these data. The higher profit margin shown for repair-parts sales is strongly affected by the transfer prices charged to the Canadian subsidiaries by their parent companies. The discounts allowed for parts and wholegoods are probably based to some degree on custom, and may reflect actual differences in cost in only a rough way. Even apart from the transfer-price question, the net profit margin depends on the fairly rough allocation of a number of cost items. Moreover, in managing a parts operation, costs may be incurred in emergency situations that do not get fully charged to the parts operation. Still, the profit division probably reflects in a rough way the profits the companies would see themselves making on these two different sectors of their operation.

TABLE 12.17–GROSS AND NET PROFITS BEFORE TAX ON WHOLEGOODS AND REPAIR PARTS FOR GROUP I AND II COMPANIES, AVERAGES FOR PERIOD 1962-66

	Wholegoods		Repair Parts	
	($'000)	(Percentage of net sales)	($'000)	(Percentage of net sales)
Gross Profits				
Total – Groups I and II	49,352	18.2	12,139	30.8
Net Profits				
Total – Groups I and II	15,620	5.8	8,018	20.3

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 6.5.

For the period since 1966, data on sales costs and profits recorded in Canada of the farm machinery companies operating in Canada were collected on a less detailed basis. A summary of these data, presented in Table 12.18, shows that total

sales for these companies reached a peak of $580 million in 1967 and have since declined by almost $90 million. While the cost of goods sold has also declined since 1967, by some $54 million, the decline has been proportionately less. As a result, gross profits have fallen sharply from their peak in 1966 of $109 million to just under $67 million in 1969. Since selling, general, administrative and other expenses have continued to rise, the result has been an extremely sharp fall in profits before tax. Indeed, between 1966 and 1969, these companies moved from a before-tax profit of $48.5 million to a net loss of almost $2 million. The after-tax situation changed over the same period from a profit of $30 million in 1966 to a net profit of only $.6 million by 1969. Details showing these changes for each of the four groups of companies are given in Tables 12.33 to 12.36, appended to this chapter.

Some further insight into this rapidly changing profit picture is provided by the data in Table 12.19 which shows for these companies their cost of goods sold, expenses, and profits, as a percentage of sales over the period 1961-69. The cost of goods sold, as a percentage of net sales, rose sharply from 80.8 per cent in 1966 to 86.4 per cent in 1969. The corresponding decline in the gross profit ratio was from 19.2 to 13.6 per cent of net sales. The data also reveal the significant rise in the ratio of net expenses (selling, general, administrative and other expenses, less interest and other income) from 10.7 per cent in 1966 to 14.0 per cent in 1969. The 1969 ratio is almost the same as that which prevailed in 1962.

No simple explanation can be provided for this sharp rise in cost and expense ratios. The data reflect very large exports and imports, and the transfer prices established on the flow of machines across the Canadian border will substantially affect the amount shown for cost of goods sold and its ratio to net sales. The increase in net expenses undoubtedly reflects the effects of inflation in general on salaries and wages and other costs. An important but undetermined amount must be due, as well, to the rise in interest rates and the cost to the farm machinery companies of the funds required to finance their accounts receivable from dealers. For some companies, these accounts are carried by their finance subsidiaries, but for at least two major companies they appear in the companies' main accounts. Although no precise data are available as to the amounts involved, there is reason to believe that a significant part of the farm machinery companies' sales in recent years have reflected a build-up of inventory in the hands of their dealers, financed by the companies on an interest-free basis. For six major companies it has been reported that between 1964 and 1968 total accounts receivable (including those held by unconsolidated finance subsidiaries) increased by $1,841 million, whereas their wholesale sales rose only by $1,265 million in this same period.[7] These data are for the international operations of the six companies.

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[7] *Special Report, The Farm Machinery Industry,* Pitfield, Mackay, Ross and Company Limited, 1969.

TABLE 12.18–CANADIAN FARM MACHINERY COMPANIES: SALES, COSTS AND PROFITS, 1961-69

(Canadian dollars)

	1961	1962	1963	1964	1965	1966	1967	1968	1969
1. Net sales	231,809	283.943	366.372	427,830	480,555	570.348	580.126	485.075	491,077
2. *Cost of goods sold*	*190,929*	*225,550*	*292,740*	*348,755*	*394,590*	*461,008*	*478,207*	*406,972*	*424,180*
3. Gross profit	40,880	58,393	73,632	79,075	85,965	109,340	101,919	78,103	66,897
4. *Selling, general, and administrative expenses*	*29,633*	*31,318*	*34,832*	*37,376*	*39,253*	*44,395*	*46,643*	*47,893*	*53,932*
5. *Other expenses*	*12,417*	13,041	*14,018*	*15,910*	*19,747*	*24,517*	*27,723*	*30,445*	*31,770*
6. *Total expenses*	*42,050*	*44,359*	*48,850*	*53,286*	*59,000*	*68,912*	*74,366*	*78,338*	*85,702*
7. Interest and other income	4,262	4,810	5,277	6,971	7,315	8,111	12,248	13,043	16,877
8. *Total expenses (net)*	*37,788*	*39,549*	*43,573*	*46,315*	*51,685*	*60,801*	*62,118*	*65,295*	*68,825*
9. Profit before tax/*loss*	3,092	18,844	30,059	32,760	34.280	48,539	39,799	12,809	*1,929*
10. *Taxes*/credit	*4,102*	*10,080*	*15,567*	*15,006*	*12,858*	*18,509*	*20,232*	*5,715*	2,567
11. Net profit/*loss*	*1,010*	8,764	14,492	17,754	21,422	30,030	19,567	7,094	638

Note: Italics indicate subtracted figures or (in lines 9 and 11) loss position.
Source: Tables 12.33, 12.34, 12.35, and 12.36.

TABLE 12.19–ANALYSIS OF REVENUES, COSTS AND PROFITS, FARM MACHINERY COMPANIES, 1961-69

(Each year's net sales (revenues) = 100)

	1961	1962	1963	1964	1965	1966	1967	1968	1969
Net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold	*82.4*	*79.4*	*79.9*	*81.5*	*82.1*	*80.8*	*82.4*	*83.9*	*86.4*
Gross profit	17.6	20.6	20.1	18.5	17.9	19.2	17.6	16.1	13.6
Net expenses	*16.3*	*13.9*	*11.9*	*10.8*	*10.8*	*10.7*	*10.7*	*13.5*	*14.0*
Profit/*loss* before tax	1.3	6.7	8.2	7.7	7.1	8.5	6.9	2.6	*.4*
Taxes/credit	*1.7*	*3.6*	*4.2*	*3.5*	*2.7*	*3.2*	*3.5*	*1.2*	.5
Net profit/*loss*	*.4*	3.1	4.0	4.2	4.4	5.3	3.4	1.4	.1

Note: Italics indicate subtracted figures or loss position.
Source: Calculated from data given in Table 12.18.

TABLE 12.20–ANALYSIS OF REVENUES, COSTS AND PROFITS, GROUP I AND II FARM MACHINERY COMPANIES, 1961-69

(Each year's net sales (revenues) = 100)

	1961	1962	1963	1964	1965	1966	1967	1968	1969
Group I (Deere, International Harvester, Massey-Ferguson, White)									
Net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold	*82.3*	*80.0*	*80.6*	*82.7*	*83.5*	*82.6*	*83.7*	*86.0*	*88.6*
Gross profit	17.7	20.0	19.4	17.3	16.5	19.4	16.3	14.0	11.4
Net expenses	*14.6*	*13.0*	*10.8*	*9.7*	*9.7*	*9.8*	*9.6*	*12.4*	*12.7*
Profit/*loss* before tax	3.1	7.0	8.6	7.6	6.8	7.6	6.6	1.7	*1.3*
Taxes/credit	*1.6*	*3.6*	*4.4*	*3.5*	*2.4*	*2.7*	*3.4*	*0.7*	1.2
Net profit/*loss*	1.5	3.4	4.2	4.1	4.4	4.9	3.2	1.0	*0.1*
Group II (Allis-Chalmers, Case, Ford, New Idea, New Holland)									
Net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold	*83.4*	*77.0*	*76.7*	*77.1*	*77.6*	*75.2*	*80.0*	*78.2*	*77.6*
Gross profit	16.6	23.0	23.3	22.9	22.4	24.8	20.0	21.8	22.4
Net expenses	*24.9*	*19.7*	*17.8*	*17.7*	*16.9*	*15.7*	*16.8*	*19.5*	*21.6*
Profit/*loss* before tax	*8.3*	3.3	5.5	5.2	5.5	9.1	3.2	2.3	0.9
Taxes	*2.6*	*3.0*	*3.4*	*1.9*	*2.5*	*3.6*	*1.6*	*1.2*	*1.1*
Net profit/*loss*	*10.9*	0.3	2.1	3.3	3.0	5.5	1.6	1.1	*0.2*

Note: Italics indicate subtracted figures or loss position.
Source: Calculated from data given in Tables 12.33 and 12.34.

A comparison of the four companies that have extensive manufacturing operations in Canada (Deere, International Harvester, Massey-Ferguson, and White Motor) with those who import almost all the machinery they sell here (Allis-Chalmers, Case, Ford, New Idea, and New Holland) reveals some significant differences. As Table 12.20 shows, the former companies have recorded a sharp rise in the ratio of cost of goods sold to net sales, whereas for the latter group of companies (apart from some significant year-to-year fluctuations) there has been no appreciable rise in this ratio. In contrast, the latter group shows a significant increase in the ratio of net expenses to net sales. These trends are roughly offsetting. As a result, both groups show about the same decline in the ratio of their profit before and after tax to net sales.

Finally, it must be emphasized that the decline in profits shown in Table 12.18 are in respect to profits reported within Canada only. As was demonstrated in Table 12.16, in 1966 on sales of farm machinery in Canada, profits earned outside Canada were somewhat larger than those earned in Canada. No information is available as to how these profits have changed since 1966. However, it is possible that they have declined a good deal less than the profits reported as earned in Canada.

Some support for this view is given by the data in Table 12.21 which compares net sales and net profits for the four largest companies producing and selling farm machinery in Canada (the Group I companies), with the net sales and profits of the international companies of which the four Canadian divisions are subsidiaries. Up until 1966 the experience of the parents and subsidiaries was similar. Both showed a substantial growth in sales and net profits. However, beginning in 1967 the profits of the Canadian subsidiaries declined sharply. Net profits recorded by the parent firms also declined, but much more moderately.

TABLE 12.21 -COMPARISON OF SALES AND PROFITS FOR GROUP I COMPANIES, CANADIAN SUBSIDIARIES AND TOTAL PARENT ORGANIZATION, 1963-69

(Millions of dollars)

	1963	1964	1965	1966	1967	1968	1969
Canadian Subsidiaries							
Net sales	306.3	353.6	390.3	455.1	451.9	364.9	358.9
Net profit/*loss*	12.9	14.3	17.4	22.4	14.4	3.6	*0.3*
Profit/*loss* as percentage of net sales	4.2	4.0	4.5	4.9	3.2	1.0	*0.1*
Parent Companies							
Net sales	4,165	4,637	4,979	5,710	5,663	5,694	6,061
Net profit	167	235	230	283	220	181	174
Profit as percentage of net sales	4.0	5.1	4.6	5.0	3.9	3.2	2.9

Note: Italics indicate loss position.

Source: Based on data collected by the Commission for Canadian companies and on *Annual Reports* of companies. Data for Canadian subsidiaries is primarily farm machinery but includes some light industrial equipment. Data for parent companies include large truck sales for two companies, International Harvester and White Motor, and large sales of heavy construction equipment for International Harvester.

While in 1969 the parent organizations showed some increase in sales and a net profit of 2.9 per cent of sales, the four Canadian subsidiaries recorded a further small drop in sales and a net loss of 0.1 per cent of sales. Since profits earned outside Canada on sales in Canada probably depend on the firm's general profitability at the manufacturing level, it seems likely that these may have moved more in line with those of the parent company as a whole. On the other hand, profits reported in Canada include profits earned on exports as well as domestic sales.

Before attempting to summarize the profits picture, a brief comparison will be made with profit levels in an earlier period. In both the twenties and thirties, the profits earned by the major farm machinery companies in the United States appear to have been much higher than in recent years. The relevant data are summarized in Table 12.22. In 1929, International Harvester earned a return on investment of 20.6 per cent. Deere's return at 30.2 per cent was even higher. Even in 1936 the

TABLE 12.22–PROFIT RATES OF MAJOR FARM MACHINERY COMPANIES, UNITED STATES, 1929 AND 1936

	Gross Profits		Net Profits		Return on Investment	
	1929	1936	1929	1936	1929	1936
	(Percentage of net sales)		(Percentage of net sales)		(Percentage)	
International Harvester	33.9	30.9	15.3	17.1	20.6	15.9
Deere	42.6	44.2	28.8	27.5	30.2	23.6
Allis-Chalmers	16.5	28.1	5.1	11.0		
Case	40.6	41.5	15.9	18.3	9.2	9.4
Oliver	34.8	31.2	10.0	7.7	7.3	6.1
Minneapolis-Moline	28.6	29.9	11.8	6.1	9.0	4.9
Massey-Harris	23.4	17.6	0.7	−2.9	0.6	−2.8

Source: Based on D. Schwartzman, *Oligopoly in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Tables 7.2 and 7.3.

two companies were still earning 16 and 23.6 per cent, respectively. Profits earned by the smaller companies were much lower than this. Moreover, the profits earned by the full- and long-line companies, 18.2 per cent on total assets before tax for the period 1927-29, were very much higher than those earned by the short-line firms, namely, 5.5 per cent (see Table 12.23).

In interpreting the profits data presented in this chapter it is useful to keep in mind certain developments that have occurred over the postwar period. The first of these was the change in the volume of sales available to each firm. Although the dollar value (at constant prices) of farm machinery sold in North America has continued to grow, the number of units manufactured for major machines has declined significantly. Tractor output declined from a peak of 567,000 in 1951 to 242,000 by 1967. Combine production fell from 134,000 in 1950 to 53,000 in 1965. This trend to fewer units reflects a number of considerations, including a decline in exports, the move to fewer and larger farms, and the filling of the

TABLE 12.23–PROFITS OF FULL- AND LONG-LINE COMPARED TO SHORT-LINE FARM MACHINERY MANUFACTURERS, UNITED STATES, 1927-29

	Gross Profits	Net Profits	Return on Total Assets (Before Tax)
	(Percentage of sales)		
Full-line and long-line	33.1	16.8	18.2
Short-line	28.7	5.1	5.5

Source: Federal Trade Commission, *Report on Agricultural Implements and Machinery Industry*, 1938, pp. 620-2.

backlog of demand that had existed at the end of the war. Whatever its cause, the effect of this decline in the number of units produced may well have been to increase the significance of economies of scale. Ten per cent of the tractor market in 1951 meant an annual output of 57,000. By 1967 a 10 per cent share amounted to only about 24,000. Because the cost penalty on small volume increases as output declines, this will mean that the major firm has a larger cost advantage over the smaller firm today than it had 20 years ago.

A second development has been the increased importance of distribution assets in company balance sheets as a result of the introduction of interest-free floor-planning for dealers and the financing of sales to farmers. For Deere & Company, the ratio of accounts receivable to net fixed assets increased from just under 2.5 to 1 in 1957 to over 4 to 1 by 1967. Thus the return to manufacturing assets are effectively masked in company statements by the large assets the farm machinery companies carry in the form of accounts receivable (or their equivalent) from farmers and dealers.

A third development that has affected the profits reported by the international companies has been the growing importance of international trade in farm machinery, especially for tractors, and in the international "sourcing" of components. (These developments are more fully described in Chapter 14, and certain aspects have also been discussed in some detail in the Commission's *Special Report on Prices.*) This comparatively recent trend suggests that profits are likely to be significantly affected in the future by the way in which the international firm deploys its manufacturing plants in different countries and sources components and machines to different markets. However, up until this date, the major part of the farm machinery sold in North America is still manufactured there.

In the light of these considerations, what conclusions are supported by the analysis of profits in the farm machinery industry? The evidence is consistent with the view that for important products such as tractors and combines the major companies have kept their prices high in relation to manufacturing costs. This has allowed the smaller companies with lower volume and higher unit costs to earn a

moderate return, survive, and even expand their share of the market. Some of the smaller firms have survived only after reorganization and a major writing-down in asset values. Thus, Oliver, Minneapolis-Moline, and Cockshutt, disappeared as independent companies during the postwar period. White Motor, which took over the assets of these three firms, closed a number of factories and consolidated production in the remaining factories to take greater advantage of economies of scale.

The high prices maintained by the major companies have attracted new entrants, and have allowed smaller firms to use price to expand their market share. As a result, the market share of the major companies has declined. For tractors, the new entrants have included British firms such as British Leyland and David Brown as well as North American firms like Versatile. Almost all firms have begun to supply the North American market for smaller-horsepower tractors with models manufactured in whole or in part in Europe. For combines, foreign-manufactured models have been important, too—as with New Holland's Clayson machines and the Claas combine first imported by C.C.I.L. and now by Ford. Versatile has also entered this market. Because the industry has moved to a higher-cost distribution system where dealers are encouraged to carry large inventories of machines by a system which provides interest-free floor-planning for up to two selling seasons, high prices have in some measure been reflected in higher costs rather than high profits.

For other products the evidence is less clear, but the declining market share experienced by the Big Three suggests that here, too, products have been priced high in relation to costs. This has enabled the smaller firms to increase their share of the market by selling at lower prices. Certainly, this appears to have been true for Versatile's invasion of the swather market. It may also have been true for gains made by smaller firms such as Morris Rod Weeder, C.C.I.L., and others in the market for diskers, and for tilling, cultivating and weeding equipment.

Thus, while on an average over a period of years the profits earned by the major farm machinery companies have been moderate when compared with those earned in manufacturing as a whole, or when compared with major firms in many other industries, the industry has followed a policy of pricing its products at a high level in relation to manufacturing costs and has developed an expensive distribution system which has effectively concealed the high profits earned at the manufacturing level. This has made them vulnerable to competition from smaller firms, even though the latter do not enjoy the same economies of large-scale production. The smaller firms have had lower distribution costs, evident in their higher rate of turnover of distribution assets. Some of them, such as Versatile and others, have manufactured their products in lower-cost locations, thus offsetting in some degree the higher costs that accompany lower-volume manufacturing operations.

TABLE 12.24–FARM MACHINERY PRODUCTS SOLD BY CANADIAN COMPANIES, BY GROUP

	Farm Machinery Products Sold in Canada
GROUP I	
John Deere Limited	Full line of agricultural implements
International Harvester Company of Canada, Limited	Full line of agricultural implements
Massey-Ferguson Industries Limited	Full line of agricultural implements
White Motor Corporation Subsidiaries: Cockshutt Farm Equipment of Canada Limited, and Minneapolis-Moline of Canada, Ltd.	Full line of agricultural implements
GROUP II	
Allis-Chalmers, Rumely, Limited	Full line of agricultural implements
Avco New Idea Farm Equipment Division, Avco Distributing Corporation	Haying, harvesting machinery
David Brown Tractors (Canada) Limited	Agricultural tractors
J. I. Case Company	Full line of agricultural implements
Ford Tractor and Equipment Sales Company of Canada, Limited	Agricultural tractors, plows, harrows, cultivators, planters, fertilizers, haying machinery, forage harvesters, cutters, combines
New Holland Division, Sperry Rand Canada Limited	Haying, harvesting machinery
GROUP III	
Versatile Manufacturing Ltd.	Four-wheel-drive tractors, hay conditioners, combines, swathers, windrowers, spraying equipment, grain elevators
GROUP IV	
Agristeel Fabricators Ltd.	Field cultivators, spraying and dusting equipment, cabs
Golden Arrow Manufacturing Limited	Dry fertilizer spreaders, spraying equipment, high pressure pumps
Killbery Industries	Hay conditioners, swathers, spraying equipment
McCoy-Renn Mfg. Ltd.	Pick-up attachments, grain rollers, post drivers, hydraulic hoists
McKee Bros. Limited	Combines, forage harvesters, wagons, implement hitches, animal waterers, snow blowers
Morris Rod Weeder Company Limited	Chisel plows, rod weeders, grain drills

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 5.1.

TABLE 12.25–WHOLESALING ACTIVITIES OF CANADIAN FARM MACHINERY COMPANIES, BY GROUP, 1966

	Branch Location	Number of Branches	Number of Franchised Retail Dealers
GROUP I			
John Deere Limited	Hamilton, Ont.; Winnipeg, Man.; Regina, Sask.; Calgary, Alta.	4	505
International Harvester Company of Canada, Limited	Saint John, N.B.; Quebec, Que.; London, Ont.; Winnipeg, Man.; Regina, Sask.; Saskatoon, Sask.; Calgary, Alta.; Edmonton, Alta.	8	616
Massey-Ferguson Industries Limited	Toronto, Ont.; Montreal, Que.; Winnipeg, Man.; Saskatoon, Sask.; Calgary, Alta.	5	715
White Motor Corporation Subsidiaries:			
Cockshutt Farm Equipment of Canada Limited	Brampton, Ont.; Winnipeg, Man; Regina, Sask.; Edmonton, Alta.; Calgary, Alta. Transfer Points: Medicine Hat, Alta.; Brandon, Man.	7	406
Minneapolis-Moline of Canada, Ltd.	Regina, Sask.; Saskatoon, Sask.; Calgary, Alta.; Edmonton, Alta.; Winnipeg, Man. Transfer Points: Toronto, Ont.; Brandon, Man.	7	206
GROUP II			
Allis-Chalmers, Rumely, Limited	Edmonton, Alta.; Fredericton, N.B.; Halifax, N.S.; London, Ont.; Ottawa, Ont.; Toronto, Ont.; Montreal, Que.; Quebec, Que.; Trail, B.C.; Vancouver, B.C.; Winnipeg, Man.	11	288
Avco New Idea Equipment Division, Avco Distributing Corporation	Waterloo, Ont.	1	92
David Brown Tractors (Canada) Limited	Halifax, N.S.; Montreal, Que.; London, Ont.; Winnipeg, Man.; Amherst, N.S.; Edmonton, Alta.; Vancouver, B.C. Parts Depot: Toronto, Ont.	8	178
J. I. Case Company	Calgary, Alta.; Winnipeg, Man.; Regina, Sask.; Montreal, Que.; Toronto, Ont.	5	421
Ford Tractor and Equipment Sales Company of Canada, Limited	Montreal, Que.; Bramalea, Ont.; Winnipeg, Man.; Regina, Sask.; Edmonton, Alta.	5	267
New Holland Division Sperry Rand Canada, Limited	Ottawa, Ont.; Winnipeg, Man.; Calgary, Alta.	3	386
GROUP III			
Versatile Manufacturing Ltd.	Ships from head office in Winnipeg, Man.; also operates a branch in Fargo, North Dakota.	2	743
GROUP IV	Not included because wholesaling activities largely carried out through independent organizations.		

Note: Marketing arrangements of Group IV companies are quite varied.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 7.2.

TABLE 12.26–FARM MACHINERY FACTORY LOCATIONS AND FACTORY EMPLOYMENT, CANADIAN FARM MACHINERY COMPANIES, BY GROUP, 1966

	Factory Location	Square Footage	Approximate Factory Employment[1]	Products Produced
GROUP I				
John Deere Limited	Welland Works, Welland, Ontario	709,000	400	Harrows, tillers, hoes, mowers, rotary cutters, windrowers, wagons, industrial equipment
International Harvester Company of Canada, Limited	Hamilton Works, Hamilton, Ontario	2,074,000	3,250	Plows, drills, manure spreaders, harrows, weeders, field cultivators, mowers, balers, baler twine, combines, windrowers, industrial equipment
Massey-Ferguson Industries Limited	Toronto, Ontario	1,904,028	2,760	Balers, pick-ups, components for Combine Plant, swathers, windrowers, corn pickers
	North American Combine Plant, Brantford, Ontario	571,675	1,100	Combines and attachments
	"M" Foundry, Brantford, Ontario	192,229	480	Castings for plants
	Verity Plant, Brantford, Ontario	522,754	1,000	Plows, sub soilers, harrows, cultivator hitches, mowers, rakes, grain boxes, hay conditioners
White Motor Corporation Subsidiary: Cockshutt Farm Equipment of Canada Limited	Brantford, Ontario	n.a.	800	Combines
GROUP III				
Versatile Manufacturing Ltd.	Winnipeg, Manitoba	187,000	500	Four-wheel-drive tractors, hay conditioners, combines, swathers, spraying equipment, grain elevators

GROUP IV				
Agristeel Fabricators Ltd.	Minnedosa, Manitoba	n.a.	190	Field cultivators, spraying and dusting equipment, cabs
Golden Arrow Manufacturing Limited	Calgary, Alberta	n.a.	50	Dry fertilizer spreaders, spraying equipment, high pressure pumps
Killbery Industries	Winnipeg, Manitoba	n.a.	150	Hay conditioners, swathers, spraying equipment
McCoy-Renn Mfg. Ltd.	Calgary, Alberta	n.a.	90	Pick up attachments, grain rollers, post drivers, hydraulic hoists
McKee Bros. Limited	Elmira, Ontario	n.a.	35	Forage harvesters, wagons, implement hitches, animal waterers, snow blowers
Morris Rod Weeder Company Limited	Yorkton, Saskatchewan	n.a.	76	Chisel plows, rod weeders, grain drills, fertilizer attachments

n.a. – not available.

[1]Number of factory workers in 1968 as given in: *Scott's Industrial Directory 1968-69,* Oakville: Penstock Publications Limited, 1968, both the Ontario and Western sections.

Source: D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 5.7.

TABLE 12.27–DOMESTIC NET SALES, EXPORTS AND IMPORTS OF FARM MACHINERY AND LIGHT INDUSTRIAL EQUIPMENT, 17 MAJOR CANADIAN FARM MACHINERY FIRMS, BY GROUP, 1966(1)

(Millions of Canadian dollars)

	Group I	Group II	Groups III & IV	Total 17 Companies
Domestic net sales				
Farm machinery	247.2	95.7	22.9	365.8
Light industrial equipment	(2)	(2)	–	39.5
	(2)	(2)	22.9	405.3
Exports				
Farm machinery	164.2	–	6.0	170.2
Manufacturing components	6.2	–	–	6.2
	170.4	–	6.0	176.4
Total net sales	(2)	(2)	28.9	581.7
Imports				
Farm machinery(3)	137.2	72.7	0.2	210.1
Light industrial equipment(3)	(2)	(2)	–	25.7
Materials and manufacturing components	42.5(4)	–	3.8	46.3
	(2)	(2)	4.0	282.1
Net exports (imports)				
Farm machinery	27.0	(72.7)	5.8	(39.9)
Light industrial equipment	(2)	(2)	–	(25.7)
Materials and manufacturing components	(36.3)	–	(3.8)	(40.1)
Balance of trade	(2) (5)	(2)	2.0	(105.7)

(1)Repair parts included in respective product categories of farm machinery and light industrial equipment.
(2)Breakdown withheld where fewer than three firms reported in a category.
(3)Breakdown of imports between farm machinery and light industrial equipment for resale estimated in some cases.
(4)$42.5 million is made up of $14.5 million imported from affiliates and $28.0 million from other sources.
(5)Balance of trade in farm machinery, $9.3 million of imports over exports, would have been $52.0 million, except for the favourable trade balance of $42.7 million shown by Massey-Ferguson Industries Limited.

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table 5.2.

TABLE 12.28 – FINANCIAL STATISTICS – CANADIAN FARM MACHINERY FIRMS, 1960-66, GROUP I – THREE FIRMS (OF FOUR)

(Thousands of Canadian dollars)

	1960	1961	1962	1963	1964	1965	1966
Distribution assets							
Wholesale notes receivable	79,623	84,297	81,477	68,072	66,946	75,636	101,856
Finished goods inventories	47,885	48,011	49,624	53,649	62,373	74,594	81,194
Total distribution assets	127,508	132,308	131,101	121,721	129,319	150,230	183,050
Retail notes receivable	26,865	26,408	39,579	51,874	71,126	94,564	102,954
Factory assets							
Raw material inventories	5,796	4,582	5,415	7,598	7,903	9,142	11,780
Work-in-process inventories	18,399	16,645	20,223	20,863	25,812	28,952	31,356
Net fixed assets	34,650	36,639	35,111	45,599	47,201	49,877	49,770
Total factory assets	58,845	57,866	60,749	74,060	80,916	87,971	92,906
Total assets	213,218	216,582	231,429	247,655	281,361	332,765	378,910
Returns							
Profit after tax	1,533	2,941	7,017	10,908	12,239	14,934	19,174
Income taxes	2,279	3,082	7,130	11,629	10,483	6,588	8,913
Profit before tax	3,812	6,023	14,147	22,537	22,722	21,522	28,087
Interest payments	6,933	6,476	6,194	6,214	6,464	8,557	10,393
Total returns	10,745	12,499	20,341	28,751	29,186	30,079	38,480
Return on assets (%)	5.0	5.8	8.8	11.6	10.4	9.0	10.2
Net sales							
Domestic wholesale sales	133,202	122,234	139,170	172,906	194,930	213,998	234,347
Export sales	76,780	70,998	75,497	90,516	108,620	116,244	153,249
Total net sales	209,982	193,232	214,667	263,422	303,550	336,242	387,596
Turnover of distribution assets (*ratio* of domestic wholesale sales to distribution assets)	1.0	0.9	1.1	1.4	1.5	1.4	1.3

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Study No. 11 (Ottawa: Information Canada, 1970), Table D.1.

TABLE 12.29–FINANCIAL STATISTICS – CANADIAN FARM MACHINERY FIRMS, 1960-66, GROUP II – FIVE FIRMS (OF SIX)

(Thousands of Canadian dollars)

	1960	1961	1962	1963	1964	1965	1966
Distribution assets							
Wholesale notes receivable	18,294	13,200	14,860	14,758	18,907	(24,121)	25,793
Finished goods inventories	14,234	14,288	14,888	13,620	13,049	13,264	17,603
Total distribution assets	32,528	27,488	29,748	28,378	31,956	37,385	43,396
Retail notes receivable	9,448	9,350	8,123	11,969	13,783	15,526	29,634
Factory assets							
Raw material inventories	–	–	–	–	–	–	–
Work-in-process inventories	–	–	–	–	–	–	–
Net fixed assets	2,265	2,573	2,866	2,615	2,560	2,717	2,878
Total factory assets	'2,265	2,573	2,866	2,615	2,560	2,717	2,878
Total assets	44,241	39,411	40,737	42,962	48,299	55,628	75,908
Returns							
Profit/(loss) after tax	(4,646)	(4,001)	121	1,200	2,004	2,166	4,966
Income taxes	1,451	958	1,228	1,927	1,154	1,844	3,313
Profit/(loss) before tax	(3,195)	(3,043)	1,349	3,127	3,158	4,010	8,279
Interest payments	1,809	2,392	1,743	1,967	2,169	2,701	3,773
Total returns/(losses)	(1,386)	(651)	3,092	5,094	5,327	6,711	12,052
Return/(loss) on assets (%)	(3.1)	(1.7)	7.6	11.9	11.0	9.3	15.9
Net sales							
Domestic wholesale sales	36,564	36,663	40,770	56,094	60,310	72,626	90,856
Export sales	–	–	–	–	–	–	–
Total net sales	36,564	36,663	40,770	56,094	60,310	72,626	90,856
Turnover of distribution assets (*ratio* of domestic wholesale sales to distribution assets)	1.1	1.3	1.4	2.0	1.9	1.9	2.1

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table D.2.

TABLE 12.30 – FINANCIAL STATISTICS – CANADIAN FARM MACHINERY FIRMS, 1963-68, GROUP III – ONE FIRM

(Thousands of Canadian dollars)

	1963	1964	1965	1966	1967	1968
Distribution assets						
Wholesale notes receivable	1,600	3,400	4,500	8,000	13,000	15,700
Finished goods inventories[1]	–	–	–	–	–	–
Total distribution assets	1,600	3,400	4,500	8,000	13,000	15,700
Retail notes receivable	–	–	–	–	–	–
Factory assets						
Raw material inventories, Work-in-process inventories[1]	300	700	1,400	2,200	6,000	8,000
Net fixed assets	300	1,500	1,600	2,200	2,500	2,800
Total factory assets	600	2,200	3,000	4,400	8,500	10,800
Total assets	2,200	5,600	7,500	12,400	21,500	26,500
Returns						
Profit after tax	900	1,200	1,400	2,200	2,800	1,600
Income taxes	–	1,300	1,400	2,400	2,900	1,700
Profit before tax	900	2,500	2,800	4,600	5,700	3,300
Interest payments	–	–	100	200	400	1,000
Total returns	900	2,500	2,900	4,800	6,100	4,300
Return on assets (%)	40.9	44.6	38.7	38.7	28.4	16.2
Net sales						
Domestic wholesale sales	5,300	5,200	6,700	11,300	15,900	13,400
Export sales	–	4,000	4,700	5,500	6,600	9,400
Total net sales	5,300	9,200	11,400	16,800	22,500	22,800
Turnover of distribution assets (*ratio* of domestic wholesale sales to distribution assets)	3.3	2.7	2.5	2.1	1.7	1.5

[1] The published *Annual Reports* of Versatile Manufacturing Limited do not segregate inventories as between factory and distribution; factory inventories above therefore includes total inventories, including some finished goods inventories.

Source: From D. Martinusen and B.P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table D.3.

TABLE 12.31–FINANCIAL STATISTICS – CANADIAN FARM MACHINERY FIRMS, 1960-66, GROUP IV – THREE FIRMS

(Thousands of Canadian dollars)

	1960	1961	1962	1963	1964	1965	1966
Distribution assets							
Wholesale notes receivable	243	355	328	497	486	622	799
Finished goods inventories	646	567	546	855	706	932	1,220
Total distribution assets	889	922	874	1,352	1,192	1,554	2,019
Retail notes receivable	–	–	–	–	–	–	–
Factory assets							
Raw material inventories	339	379	324	140	634	405	553
Work-in-process inventories	45	60	27	36	118	98	161
Net fixed assets	316	359	454	479	588	669	770
Total factory assets	700	798	805	655	1,340	1,172	1,484
Total assets	1,589	1,720	1,679	2,007	2,532	2,726	3,503
Returns							
Profit/(loss) after tax	(1)	93	356	480	425	484	459
Income taxes	23	57	277	233	139	265	272
Profit before tax	22	150	633	713	564	749	731
Interest payments	32	53	54	47	51	71	96
Total returns	54	203	687	760	615	820	827
Return on assets (%)	3.4	11.8	40.9	37.9	24.3	30.1	23.6
Net sales							
Domestic wholesale sales	2,499	2,645	3,666	4,308	4,770	5,571	6,748
Export sales	–	–	–	–	97	137	209
Total net sales	2,499	2,645	3,666	4,308	4,867	5,708	6,957
Turnover of distribution assets (*ratio* of domestic wholesale sales to distribution assets)	2.8	2.9	4.2	3.2	4.0	3.6	3.3

Source: From D. Martinusen and B. P. Barry, *Revenues, Costs and Profits in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 11 (Ottawa: Information Canada, 1970), Table D.4.

TABLE 12.32–EXAMPLES OF POSSIBLE PATTERNS OF DISTRIBUTION OF PROFITS EARNED ON SALES IN CANADA BETWEEN CANADA AND OTHER COUNTRIES

	Companies Selling Products Wholly Made or Assembled in Canada			Companies Selling Some Products Made Wholly in Canada; Some Products Made Wholly by Associated Companies Outside Canada				Companies Selling Products Wholly Made or Assembled by Associated Companies Outside Canada			
	(Example: Versatile)			(Examples: Massey-Ferguson, John Deere, International Harvester, Cockshutt)				(Examples: J. I. Case, Allis-Chalmers, Ford, New Holland, etc.)			
	Dealer-Customer Transaction	Company-Dealer Transaction	Manu-facturing-Distribution Transaction	Dealer-Customer Transaction	Company-Dealer Transaction	Manufacturing-Distribution Transaction		Dealer-Customer Transaction	Company-Dealer Transaction	Manufacturing-Distribution Transaction	
						Inside Canada	Outside Canada (Associated companies)			Inside Canada	Outside Canada (Associated companies)
Value of sales at companies' suggested retail prices	100			100				100			
Value of sales to dealer at companies' net wholesale prices	(73)	73		(73)	73			(73)	73		
Dealer gross margin	27			27				27			
Cost of sales at transfer price from manufacturing to wholesaling division		(61)	61		(61)	30.5	30.5		(61)	–	61
Distribution gross margin		12			12				12		
Distribution costs		(10)			(10)				(10)		
Company distribution profit		$\boxed{2}$			$\boxed{2}$				$\boxed{2}$		
Company manufacturing cost			(54)			(27.0)	(27.0)			–	(54)
Company manufacturing profit			$\boxed{7}$			$\boxed{3.5}$	3.5			$\boxed{0}$	7
Company profit visible in Canada		$\boxed{9}$			$\boxed{5.5}$				$\boxed{2}$		
Total global company profit on sales in Canada		9				9				9	

TABLE 12.33–GROUP I CANADIAN FARM MACHINERY COMPANIES, SALES, COSTS AND PROFITS, 1961-69

(Thousands of Canadian dollars)

Group I (4 Companies)	1961[1]	1962	1963	1964	1965	1966	1967	1968	1969
1. Net sales	193,232	239,988	306,342	353,595	390,334	455,082	451,922	364,904	358,903
2. *Cost of goods sold*	*158,984*	*192,013*	*246,943*	*292,406*	*325,866*	*375,750*	*378,478*	*313,780*	*317,854*
3. Gross profit	34,248	47,975	59,399	61,189	64,468	79,332	73,444	51,124	41,049
4. *Selling, general and admin. expenses*	*22,032*	*24,171*	*26,312*	*27,544*	*28,063*	*31,837*	*32,541*	*33,279*	*37,454*
5. *Other expenses*	*9,865*	*11,108*	*11,700*	*13,417*	*16,696*	*20,219*	*22,202*	*23,604*	*23,623*
6. *Total expenses*	*31,897*	*35,279*	*38,012*	*40,961*	*44,759*	*52,056*	*54,743*	*56,883*	*61,077*
7. Interest and other income	3,672	4,208	4,853	6,507	6,866	7,459	11,152	11,802	15,299
8. *Total expenses (net)*	*28,225*	*31,071*	*33,063*	*34,454*	*37,893*	*44,597*	*43,591*	*45,081*	*45,778*
9. Profit before tax/*loss*	6,023	16,904	26,336	26,735	26,575	34,735	29,853	6,043	*4,729*
10. *Taxes*/credit	*3,082*	*8,585*	*13,399*	*12,389*	*9,177*	*12,380*	*15,440*	*2,400*	4,466
11. Net profit/*loss*	2,941	8,319	12,937	14,346	17,398	22,355	14,413	3,643	*263*

Note: Italics indicate subtracted figures or (in lines 9 and 11) loss position.

[1] Three companies.

Source: General and Financial Information Questionnaire.

TABLE 12.34–GROUP II CANADIAN FARM MACHINERY COMPANIES, SALES, COSTS AND PROFITS, 1961-69

(Thousands of Canadian dollars)

Group II (5 companies)	1961	1962	1963	1964	1965	1966	1967	1968	1969
1. Net sales	36,663	40,770	56,094	60,310	72,626	90,856	97,969	88,576	89,218
2. *Cost of goods sold*	*30,589*	*31,408*	*43,010*	*46,494*	*56,387*	*68,318*	*78,426*	*69,244*	*69,189*
3. Gross profit	6,074	9,362	13,084	13,816	16,239	22,538	19,543	19,332	20,029
4. *Selling, general and admin. expenses*	*7,246*	*6,766*	*8,051*	*8,641*	*9,815*	*10,936*	*12,356*	*12,652*	*13,946*
5. *Other expenses*	*2,453*	*1,837*	*2,216*	*2,354*	*2,794*	*3,882*	*5,047*	*5,770*	*6,647*
6. *Total expenses*	*9,699*	*8,603*	*10,267*	*10,995*	*12,609*	*14,818*	*17,403*	*18,422*	*20,593*
7. Interest and other income	583	590	311	338	381	560	986	1,128	1,354
8. *Total expenses (net)*	*9,116*	*8,013*	*9,956*	*10,657*	*12,228*	*14,258*	*16,417*	*17,294*	*19,239*
9. Profit before tax/*loss*	*3,042*	1,349	3,128	3,158	4,010	8,279	3,125	2,038	790
10. *Taxes*/credit	*958*	*1,228*	*1,927*	*1,154*	*1,844*	*3,313*	*1,578*	*1,054*	*938*
11. Net profit/*loss*	*4,000*	121	1,201	2,004	2,166	4,966	1,547	984	*148*

Note: Italics indicate subtracted figures or (in lines 9 and 11) loss position.
Source: General and Financial Information Questionnaire.

TABLE 12.35–GROUP III, SALES, COSTS AND PROFITS OF VERSATILE MANUFACTURING, 1964-69

(Thousands of Canadian dollars)

Group III (1 company)	1964	1965	1966	1967	1968	1969
1. Net sales	9,199	11,376	16,816	22,506	22,757	33,787
2. *Cost of goods sold*	*6,368*	*7,998*	*11,443*	*15,638*	*17,586*	*30,001*
3. Gross profit	2,831	3,378	5,373	6,868	5,171	3,786
4. *Selling, general and admin. expenses*	*379*	*563*	*632*	*872*	*1,006*	*1,420*
5. *Other expenses*	*24*	*80*	*178*	*379*	*959*	*1,339*
6. *Total expenses*	*403*	*643*	*810*	*1,251*	*1,965*	*2,759*
7. Interest and other income	113	54	57	74	93	111
8. *Total expenses (net)*	*290*	*589*	*753*	*1,177*	*1,872*	*2,648*
9. Profit before tax	2,541	2,789	4,620	5,691	3,299	1,138
10. *Taxes*/credit	*1,303*	*1,411*	*2,368*	*2,882*	*1,699*	*587*
11. Net profit	1,238	1,378	2,252	2,809	1,600	551

Note: Italics indicate subtracted figures.
Source: *Annual Reports* of company.

TABLE 12.36–GROUP IV CANADIAN FARM MACHINERY COMPANIES, SALES, COSTS AND PROFITS, 1961-69
(Thousands of Canadian dollars)

Group IV (3-4 companies)	1961[1]	1962[1]	1963[1]	1964[1]	1965[1]	1966[1]	1967[2]	1968[2]	1969[2]
1. Net sales	1,914	3,185	3,936	4,726	6,219	7,594	7,729	8,838	9,169
2. *Cost of goods sold*	*1,356*	*2,129*	*2,787*	*3,487*	*4,338*	*5,496*	*5,665*	*6,362*	*7,136*
3. Gross profit	558	1,056	1,149	1,239	1,881	2,098	2,064	2,476	2,033
4. *Selling, general and admin. expenses*	*355*	*381*	*470*	*812*	*813*	*990*	*874*	*956*	*1,112*
5. *Other expenses*	*99*	*95*	*102*	*115*	*177*	*238*	*95*	*112*	*161*
6. *Total expenses*	*454*	*476*	*572*	*927*	*990*	*1,228*	*969*	*1,068*	*1,273*
7. Interest and other income	7	11	18	13	14	35	36	20	113
8. *Total expenses (net)*	*447*	*465*	*554*	*914*	*976*	*1,193*	*933*	*1,048*	*1,160*
9. Profit before tax	111	591	595	325	905	905	1,131	1,428	873
10. *Taxes*/credit	*62*	*267*	*241*	*160*	*426*	*448*	*332*	*562*	*374*
11. Net profit	49	324	354	165	479	457	799	866	499

Note: Italics indicate subtracted figures.
[1] Four companies.
[2] Three companies.
Source: General and Financial Information Questionnaire.

Chapter 13

EVALUATION OF THE INDUSTRY'S PERFORMANCE

The conclusions reached in this section of the Commission's Report can be summarized under three major headings: (1) structure of the market, (2) competitive behaviour and performance of the industry, and (3) recommendations.

Structure of the Market

Characteristics of the industry on both the demand and cost side have discouraged the entry of new firms and contributed to the high level of concentration that exists for many products.

On the demand side, the highly seasonal nature of sales and their erratic year-to-year fluctuations have favoured the growth of the large international company which can sell in a number of different market areas and thus achieve a more uniform sales level. This levelling-out of sales and production provides the larger firm with lower costs than can be achieved by the small firm selling in a single market. The comparatively slow longer-term growth in demand for farm machinery has had a similar effect.

Because many farm machines are complex durable products, whose timing in use is often critical, provision for service and the supply of repair parts is an essential component in the successful sale of farm machinery. The major companies all maintain their own branch-house distribution systems and sell their products through franchised dealers whose operations are closely supervised. The companies support their dealers in many ways, through special training programs for dealer personnel, by managerial advice, by the provision of service manuals and advertising material, and most important of all by providing a stock of their machines on an interest-free floor-planning basis. Since dealers are discouraged from handling the competitive products of other companies, any new entrant to the industry faces a major barrier in the form of the cost and effort required to develop a distribution network. Sales through independent wholesalers tend to be limited to less complex products where provision for emergency repair parts service is not important. In recent years, too, company finance plans, which allow the franchised dealer to sell to the farmer on credit, have been used to support the competitive position of the major companies.

On the cost side, the importance of economies of scale for tractors, combines, and other products, has made it difficult for the smaller firms to compete effectively with the largest firms in the industry. For tractors, manufacturing costs per unit decline about 20 per cent as output increases from 20,000 tractors a year to 90,000. As a result, a factory price that will yield a plant producing 20,000 tractors a year a return of about 12 per cent on invested capital will provide a return of about 33 per cent for a 60,000-tractor plant and 45 per cent for a 90,000-unit plant. Data for combines are less precise but here, too, economies of scale appear substantial. For a plant producing only 5,000 combines a year, unit manufacturing costs are estimated to be 15 per cent higher than they are at 20,000-units per year. Firms producing tractors and combines along with other farm machines may gain some of the economies that go with larger-volume production by producing components for different machines at one location. Rough estimates indicate that economies of scale are also important for activities beyond the plant level—activities such as research, financing, and wholesale distribution. These economies relate to the total firm size rather than to the production volume of a single product line. Costs may decline by 20 per cent or more as sales increase from $100 million to $450 million annually.

Thus, at both the plant and firm level, economies of scale are a significant barrier to the entry of new firms. Three plants of an efficient size could supply all of North America's current annual requirement for wheeled tractors. Two or three plants could produce all the combines that are sold annually.

These barriers to the entry of new firms have contributed to the high degree of concentration that exists for many of the industry's major products. The four leading firms in the industry account for 67 per cent of tractor sales in Canada, 69 per cent of combine sales, and 69 per cent of the sales of haying equipment. A similar level of concentration exists in the United States.

Although barriers to entry are substantial, this has not prevented new firms from entering. Indeed, the share of the Big Three—International Harvester, John Deere, and Massey-Ferguson—has fallen in almost every major product line over the past decade in the Canadian market. This has been due partly to the fact that the major firms have maintained prices at levels high enough to attract new entrants or allow smaller firms to expand in spite of the barriers that exist. The high prices are evident in the much larger returns that can be earned on invested capital at higher volumes of output. However, the result has not always shown up as high profits. There is some evidence that the major firms have not fully utilized the economies of scale that are potentially available. Barriers to entry can protect inefficiency and high costs of production as well as high profits.

Some further support for this thesis is provided by evidence presented in the Commission's *Special Report on Prices.* This evidence showed that profit margins were particularly large on the higher-horsepower tractors. And this is the sector of the market where the share of the Big Three has been declining. Some of this

decline reflects the success with which different firms have developed and marketed their larger-horsepower models. But it has been the existence of high prices in this sector of the market that has permitted the smaller firms the success they have enjoyed.

Competitive Behaviour

Where major companies account for a significant share of the market, they avoid price competition for fear of provoking retaliation, which would produce lower profits for all concerned. Major firms instead concentrate on various forms of non-price competition such as the development of improved products, an increased number of sizes, options, and models for each major product line, better sales promotion through improved dealer organization, better repair parts service, more emphasis on quality reflected in improved warranty provisions, and extension of customer credit. Smaller firms are likely to place more emphasis on price competition, since the effects of their price cuts on the sales of any one firm are smaller and less likely to produce counteraction. Consider the evidence in each of these areas.

Price Competition – One evidence of the policy of price restraint in price competition pursued by the major firms in North America has been the high expected rates of return to investment in new manufacturing facilities, especially in the case of higher-horsepower tractors where the market has been growing rapidly. Using data provided by its special study on *Farm Tractor Production Costs* the Commission estimates that 90 HP tractor prices prevailing in Canada in 1967 would yield a before-tax return on manufacturing assets of 49 per cent in a plant producing 60,000 tractors a year, and 61 per cent in a plant producing 90,000 tractors. For 130 HP tractors these returns increase to 76 and 92 per cent, respectively. Even a plant producing only 20,000 tractors a year would earn a return of 26 per cent on its 90 HP models and 48 per cent on its largest models. North American producers at all three levels of production would suffer losses on 40 HP tractors. The tractors in the latter size range which are sold in Canada are mainly imported from Western Europe. However, as was documented at length in the Commission's *Special Report on Prices,* these smaller tractors (those below 65 HP) have been sold in Canada at very much higher prices than in England or a number of other European countries. In the 1968 selling season, the net wholesale price to dealers on these tractors ranged from 30 to 45 per cent higher in Canada than in Britain. The companies have been able to maintain these price differences–despite an absence of tariffs on imports into Canada–by exercising tight control over the sale of tractors for export in Britain.

For North America it seems clear that Deere is the price leader for tractors and other major farm machines, and it has evidently set a price which has not only enabled it to earn a high return on its tractor manufacturing assets but has also allowed the smaller firms to survive. Economies of scale are important for combines, too, and the survival of smaller-scale manufacturing operations for

combines suggest that here, also, the major firms establish prices that will yield high returns on invested capital at larger volumes of output.

An examination of tractor prices in different Western European countries indicates that the major international companies establish prices in each country to meet local competitive conditions. As a result, the price differences between countries often exceed the tariff and transport costs that separate these markets.

Non-Price Competition - Product improvement has long been a major characteristic of competition in the farm machinery industry. As demonstrated elsewhere in this Report (see Chapter 17), it is a form of competition that has yielded very large benefits to society generally in the form of lower production costs in agriculture. In the past, these improvements have derived from many sources from inventions by farmers, from the inventive genius of individuals like Harry Ferguson, from the research carried on by the machinery companies, and from ideas adapted from other industries.[1] Today, however, the R&D expenditures of the major companies are very large in absolute terms (Deere alone spends more than $45 million a year) and are likely to be a major source of improvements in the future. Unless the smaller companies are supported by a larger public expenditure of funds in this area, they are likely to face increasing difficulty in competing effectively with the industry's giants. New product developments and improvements on older products are a particularly effective form of competition because they may offer the farmer a cost reduction that will outweigh any compensating price reduction that firms with unimproved products can afford to make. Other firms must improve their products too, if they are to stay alive. Product improvements have often caused dramatic shifts in market shares for individual products in the past. Today, with all the larger firms engaged in continuous programs of product improvement involving substantial expenditures, these shifts are likely to be less frequent and less dramatic.

Not all of the R&D expenditures result in genuine benefits. In recent years, there has been an increasing emphasis in the industry on new models and on providing a greater range of sizes and options from which the farmer can choose. In an industry where output volume is often too small to yield individual firms the full benefit of the lower costs that go with large-scale production, this emphasis on more options, sizes, and models has further fragmented production and added to the underlying cost of farm machinery. It is a kind of development that is only possible in an industry where price competition is under restraint.

Retail Distribution -- All the full- and long-line companies place a major emphasis on organizing and developing a network of dealers to distribute their products. Farmers, of course, have an important interest in having ready access to farm machinery dealers who can give them advice on their new machinery purchases, provide them with prompt and efficient service when their machinery

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[1] A.G. Vicas, *Research and Development in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 7 (Ottawa: Queen's Printer, 1970).

needs repair, and look after their warranty and other needs. Thus in this area the interests of the farmer and the farm machinery companies are often identical. However, unlike some other suppliers of farm products, the machinery companies have done little to develop a machinery advisory service capable of giving the farmer competent advice on machine capacity and replacement, and on other technical aspects of the farmer's investment decision (see Chapter 25).

To the machinery companies, the dealer network is a major component of their sales effort. Sales quotas are worked out for dealers and they are encouraged to carry large inventories of the company's machines on their premises. The sale of competitive products of rival firms may not be actually forbidden, but it is actively discouraged. Dealer sales activities are closely supervised by company representatives who may even assist in making sales.

Performance

An evaluation of an industry's performance is primarily concerned with its efficiency and its progressiveness over time. Efficiency will be reflected in production costs, the price of its products and its profit level. Progressiveness will be reflected both in improvement of the industry's final product and in the productivity gains achieved by the industry over time. Consideration will be given to both manufacturing and distribution.

Efficiency – At the manufacturing level, there is evidence that the industry does not fully utilize the economies available from large-scale manufacturing. One estimate prepared for the Commission shows that North American tractor production costs would be reduced by about 8 per cent if tractor production were concentrated in a smaller number of larger plants. This would reduce the price of an average-sized tractor at the factory level by about $400. Similar savings may be available for combines and some other products. Examination of the existing structure of plants in the industry suggests that other kinds of inefficiency may also exist in this industry. Plants representing older technologies–with layouts that are poor by current standards, with high costs for handling materials, and lower over-all productivity–have survived in the industry. At least in part, this survival has been possible because prices have been kept at levels that are high in relation to manufacturing costs in a new plant of an optimum size.

On the other hand, some sectors of the industry have redeployed their resources more efficiently on an international basis. Many of the newer tractor plants constructed by the industry have been in Western Europe, where manufacturing costs are substantially lower. The Commission has estimated that, in 1968, manufacturing costs for tractors in Britain were about 25 per cent lower than in the United States at the same output volume. However, the benefits of these lower costs have been passed on to consumers in North America only to a very limited extent. The major portion of the tractors supplied to North American farmers are still manufactured on this continent. And those that are imported are sold at higher prices than in Western Europe.

For combines there is also a small importation from lower-cost sources in Belgium and Germany. However, even within Western Europe production by some of the major companies such as Massey-Ferguson is fragmented among different plants. The result must be higher costs than a more efficient structure of plants would make possible. However, the bulkiness and high cost of shipping combines make it unlikely that large-scale imports of combines into North America will develop.

At the dealer level, the industry has moved a long way towards a more efficient organization of resources. Most farm machinery is sold by dealers who have reached a reasonably efficient size. While many smaller dealerships remain, their total sales are small. Moreover, small dealers may be inevitable in sparsely settled areas. Thus, the potential gain that could be made by concentrating farm machinery sales into fewer and larger dealerships is probably negligible.

In contrast, at the wholesale distribution levels there are still significant savings that could be made. Some of these reflect savings that could be made in the costs of dealer supervision if the companies concentrated their sales into a smaller number of larger dealers. However, the reduction in dealer numbers has been proceeding apace, and some of the potential saving may already have occurred. There is also reason to believe that the practice of floor-planning new machinery on an interest-free basis adds unnecessarily to the cost of distributing farm machinery. The major companies may find the practice useful as a device to keep their machines on view near the farmer and to avoid a loss of sales from temporary shortages, but the extra cost resulting from the practice must be absorbed by the farmer.

Profit levels fluctuate rather widely in the farm machinery industry. However, on the average, profit levels have been moderate compared with those earned by other manufacturing industries. Between 1948 and 1957, the industry in the United States earned an estimated average rate of return, after taxes, of 4.6 per cent on total assets compared with 5.0 per cent in all manufacturing. Between 1958 and 1965, the comparable returns were 4.8 per cent and 6.2 per cent respectively. The comparatively low profit levels and the small increase between the two periods in relation to total manufacturing industry are partly due to the industry's failure to take full advantage of economies of scale. Moreover, the moderate over-all returns may include high profits on tractors and combines and much lower profits on other products. Profit rates are also affected by the very large distribution assets carried by the industry, either directly as inventory or indirectly in the form of accounts receivable from their dealers and farmer customers.

Profit rates have varied substantially among the companies, but are now significantly lower than they were before the Second World War. Deere has been consistently able to earn a much higher rate of return than other firms in the industry. Profits have been low for some of the smaller firms, such as Case, and the firms later acquired by White Motor (Oliver, Cockshutt, and Minneapolis-Moline).

In general, the evidence is consistent with the hypothesis that the leading firms in the industry have maintained prices that are high in relation to the costs of a large-volume operation, and this has permitted the smaller firms to survive.

Technological Progress – As mentioned above, R&D expenditures in the industry are large and have increased significantly over the past few decades. The resulting improvement in farm machinery has contributed to a very large reduction in labour requirements in agriculture. As farm machinery has steadily become larger, more complex, and more sophisticated, the introduction of significant improvements has become increasingly dependent on the expenditures of large companies. Many new developments in the past originated with the ideas of individual farmers. This still occurs. And companies of modest size often make important contributions. But the balance of advantage appears to be swinging to the major R&D establishments maintained by the larger companies.

Although the contributions of the industry have been large and important, it is not easy to evaluate them against a scale of what they *could* have done. If the major companies are open to criticism, it is in respect to their slowness in moving into more basic types of research. But in this area the efforts of our universities and governments have been sadly deficient as well.

Although precise evidence is lacking, it is the Commissioner's view that the industry has greatly improved the quality of its products over the past few decades. Warranties are now available on most if not all farm machines, and over time they have been improved and extended. All the major companies have both laboratory facilities, in which they carry out extensive tests on the materials and components that go into their machines, and test facilities for their final machines. Failures still occur, and there is room for further improvement, but substantial progress has been made.[2]

In concluding this evaluation of the industry's performance it will be useful to consider briefly the direction in which it would seem desirable for the industry to move. Would the farm machinery industry be better able to supply the farmer with a quality product at reasonable prices and maintain a continuous flow of improvements if, like the automobile industry, there were just three or four full-line firms in the industry instead of eight or nine? It is clear from the evidence presented in this Report that a number of the full-line firms selling farm machinery today do not have enough sales volume on tractors, combines, and other major products, to achieve adequate economies of scale. As a result, their production costs on many products are from 10 to 20 per cent higher than they need be. Even some of the largest firms such as Deere and International Harvester do not have a sales volume on tractors and combines that gives them the full advantage of large-scale production.

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[2] G. F. Donaldson, *Farm Machinery Testing,* Royal Commission on Farm Machinery, Study No. 8 (Ottawa: Queen's Printer, 1970).

On the other hand, unlike the automobile industry, the farm machinery industry produces a very diverse range of products. The industry structure that would achieve the maximum economies of scale on tractors may not be suitable for tillage equipment or other machines. Moreover, there is some evidence that important innovations often come from smaller firms. Toynbee has argued that world history affords many instances where a challenge, provided it is not too severe, produces a response. The smaller firm, which is under more severe competitive pressure, may well be the one that responds to the challenge of potential innovation.

A solution providing more of the economies of scale that come from larger-volume production, yet not sacrificing the variety and competitive challenge that accompany eight or nine rather than three or four full-line firms, is for more integration on an international basis. If firms such as Case, Allis-Chalmers, and White Motor, whose annual tractor sales are 20,000 or less, were to develop working arrangements with some of the smaller independent European firms such as David Brown, Renault, or Fiat, it might be possible to achieve a production volume that would give them many more scale economies than they now obtain. They would also obtain some of the benefit that accrues under present exchange-rate levels from lower-cost European production. Major firms like Deere and International Harvester as well might be able to reduce their costs significantly by a greater integration of their tractor production on an international basis. Some of these same benefits might be attained on combines and other major products as well. In some measure, the industry has been moving in this direction. But there is clearly room for further international integration of the industry.

Recommendations

The following recommendations are designed to make the farm machinery industry adopt policies oriented more towards lower costs and lower prices. Lower manufacturing costs could be achieved through larger-volume production in individual plants. Lower distribution costs could be achieved if there were less emphasis on selling methods that result in large inventories of finished machines in the hands of the dealer. Some reduction in wholesale distribution costs could also be obtained by a further rationalization of the dealer distribution networks to eliminate the very small dealers, who account for a disproportionate share of branch-house distribution costs. If lower manufacturing costs were to be obtained on the basis of the North American market alone, it would undoubtedly involve some reduction in the number of firms now selling on a full-line basis in the Canadian market. However, such a reduction may be avoided if the smaller North American firms can integrate their manufacturing operations for tractors and other major products with those of the larger independent manufacturers in Western Europe.

Because Canada is just one segment of the large North American market, with many of the farm machines sold in Canada being manufactured in the United States

and a major part of Canadian production being sold outside Canada, it is not easy to devise measures that will have substantial effects. Nevertheless, the following measures should be influential in making the Canadian market more competitive. They would clearly be more effective if the U.S. government were to adopt similar measures.

(1) The government should prohibit the floor-planning of new and used farm machines on an interest-free basis in the hands of the dealers. To be effective this measure would need to be supported by a ban on consignment selling, and a provision for minimum interest rates on sales to dealers on a credit basis. Such a measure would force dealers to give more consideration to the interest cost of the inventory they hold, and should make it easier for short-line firms to compete with the established long-line firms at the distribution level. The rationale of this measure and some suggestions for its gradual implementation are elaborated in Chapter 11.

(2) Some steps should be taken to increase the availability of financing to farm machinery dealers. In particular it is recommended that an Act which provides for insurance of the risk on loans to dealers, somewhat comparable to that currently provided for farmers under the Farm Improvement Loans Act, should be instituted. The Industrial Development Bank should also assume a more active role in providing loans to dealers. Loans should be restricted to dealers who have already reached—or have a good prospect of reaching—an efficient size.

(3) Agreements that require dealers to handle only machines of the company in question, known as exclusive-dealing agreements, should be made illegal, as is already the case in the United States.

(4) Mergers that are likely to significantly lessen competition in the farm machinery industry should be prohibited, unless it can be shown that they have important cost-saving effects. In the latter case, they might be allowed if there is reasonable assurance that the cost-saving effects would be passed on, in substantial measure, to the farmer.

(5) The Canadian government should explore, with appropriate U.S. authority, the possibility of the United States, too, enforcing a ban on interest-free floor-planning, supported by whatever steps are needed to ensure the availability of adequate credit for farm machinery dealers.

(6) In any future revision of the Farm Improvement Loans Act adequate consideration should be given to the role that this Act has played in making the farm machinery industry in Canada more competitive. The availability of finance under this legislation has undoubtedly facilitated the growth of Versatile, C.C.I.L., and a number of short-line firms. It is important that funds for the finance of new purchases of farm machinery be readily available through the chartered banks and other financial institutions, and that these institutions have an incentive to compete actively for this business.

(7) It is recommended to the various farm organizations that they take steps to make sure their members are fully aware of the cost savings of which they can take advantage by financing through the Farm Improvement Loans Act rather than under the finance plans provided by the major companies.

(8) While the sale of farm machinery on an interest-free basis outside the normal season of use plays a useful and desirable role in the industry, the same is not true of the sale of farm machinery on an interest-free basis during the normal selling season. A ban should be placed on in-season interest-free sales to farmers. In addition, the Farm Improvement Loans Act should be revised to make it clear that farmers who buy new machinery on an interest-free out-of-season basis can finance their machines under the Act when the interest-free period ends.

(9) When the Ontario Federation of Agriculture was attempting to import tractors from Britain, its Director of Marketing and Research, Mr. David Crone, was at one time warned by a solicitor for Ford Motor Company of Canada Limited that, in importing Ford tractors, they might be violating the law by using Ford's English trade mark in Canada.[3] The Commission understands that Canadian trade mark legislation allows a company to cut off any trade in products bearing its trade mark, or the mark of which it is the registered holder in Canada. Clearly, it is not in Canada's interest to allow a company to use a trade mark to create artificial barriers to trade. The Economic Council of Canada is currently examining the use of trade marks and will undoubtedly be making some recommendations in this area. The experience cited above supports the view that present legislation needs a thorough revision.

[3] Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, 1969), p. 209.

PART III

COMPETITIVE POSITION OF THE INDUSTRY IN THE NORTH AMERICAN AND WORLD MARKET

Chapter 14

THE PATTERN OF WORLD TRADE IN FARM MACHINERY

In 1966, trade in farm machinery, as measured by the value of exports, amounted to just under $1,900 million. Of this total, about 54 per cent is accounted for by tractors, an additional 30 per cent by harvesting and haying equipment, 10 per cent by cultivating machines, and the balance by dairy and other equipment. Almost 80 per cent of this trade takes place between the advanced industrial countries, namely the United States, Canada, the western European nations, Australia, New Zealand, South Africa, and Japan. However, there are also substantial exports to the developing areas which in 1966 amounted to about $400 million.[1]

As Tables 14.1, 14.2, and 14.3 indicate, four countries—the United States, Britain, West Germany, and Canada—have accounted for a very large proportion of total exports of farm machinery throughout the postwar period. However, their share has declined from 90 per cent in 1958 to 75 per cent in 1966. Of these four, the United States is by far the dominant exporting country, accounting in 1966 for about one-third of total exports of farm machinery and 38 per cent of the exports of tractors. Britain is a strong second and in recent years has accounted for about 21 per cent of the total and about 30 per cent of total tractor exports. Over the postwar period as a whole, there is some evidence that North America's share in the world farm machinery market has been declining, whereas the share held by Western Europe has been growing. Exports from Canada and the United States amounted to almost 60 per cent of the total exports in 1952, but by 1966 had fallen to 42 per cent.

In contrast, three smaller countries—Belgium, Denmark, and The Netherlands —have increased their share of the market from 1.0 per cent in 1952 to 7.3 per cent in 1966. The growth in Belgium's share, from 0.8 per cent in 1958 to 4.6 per cent in 1966, has been particularly striking, and undoubtedly reflects exports from the

[1] These totals do not include trade among countries in the Communist bloc, since few accurate data are available on this trade. In addition, these totals probably overstate total trade in farm machinery and the share of tractors in this total, because the Standard International Trade Classification, from which these data are drawn, groups all tractors together. Thus the totals include heavy-duty construction tractors as well as agricultural tractors.

TABLE 14.1–EXPORTS OF FARM MACHINERY, FROM MAJOR EXPORTING COUNTRIES, 1952, 1958, 1964, AND 1966

	1952		1958		1964		1966	
All Farm Machinery	Millions of U.S. Dollars	Percentage	Millions of U.S. Dollars	Percentage	Millions of U.S. Dollars	Percentage	Millions of U.S. Dollars	Percentage
25 Major countries	908.2	100.0	1,048.6	100.0	1,640.5	100.0	1,894.1	100.0
10 Leading countries (in order of 1966 volume)								
United States	430.2	47.4	433.8	41.4	619.9	37.7	628.5	33.2
Britain	185.8	20.4	262.6	25.0	377.7	23.1	397.4	21.0
West Germany	97.3	10.7	140.6	13.4	209.3	12.7	224.5	11.9
Canada	112.6	12.4	109.8	10.5	137.9	8.4	160.8	8.5
France	27.1	3.0	26.0	2.5	71.3	4.3	93.2	4.9
Belgium-Luxembourg	2.6	0.3	7.9	0.8	38.7	2.4	86.4	4.6
Italy	16.9	1.9	14.6	1.4	45.3	2.8	81.4	4.3
Sweden	18.8	2.1	23.6	2.3	44.8	2.7	48.9	2.6
Denmark	5.1	0.6	12.0	1.1	24.4	1.5	29.3	1.5
The Netherlands	1.0	0.1	3.8	0.4	19.6	1.2	24.1	1.2
Farm Machinery, Excluding Tractors								
25 Major countries	377.9	100.0	391.6	100.0	765.8	100.0	865.7	100.0
10 Leading countries (in order of 1966 volume)								
United States	140.8	37.2	123.1	31.4	225.6	29.4	213.3	24.6
Canada	98.6	26.1	98.0	25.0	123.9	16.2	153.0	17.7
West Germany	32.9	8.7	61.3	15.7	142.3	18.6	144.7	16.7
Britain	59.5	15.7	47.0	12.0	82.0	10.7	85.1	9.8
Belgium-Luxembourg	2.4	0.6	7.6	1.9	38.5	5.0	48.0	5.5
France	14.7	3.9	11.2	2.9	37.7	4.9	45.3	5.2
Sweden	15.4	4.1	15.8	4.0	30.1	3.9	33.3	3.8
Denmark	5.1	1.3	11.8	3.0	23.9	3.1	29.0	3.3
The Netherlands	0.9	0.2	3.6	0.9	18.6	2.4	23.3	2.7
Italy	1.8	0.5	3.9	1.0	9.0	1.2	21.8	2.5

Tractors								
25 Major countries	530.3	100.0	657.0	100.0	874.7	100.0	1,028.4	100.0
8 Leading countries (in order of 1966 volume)								
United States	289.4	54.5	310.7	47.4	394.4	45.2	395.1	38.4
Britain	126.3	23.4	215.6	32.8	295.7	33.8	312.3	30.4
West Germany	47.1	8.9	79.3	12.1	67.0	7.7	79.8	7.8
Italy	14.9	2.8	10.7	1.6	36.2	4.1	59.6	5.8
France	14.6	2.8	14.8	2.3	33.6	3.8	47.9	4.7
Belgium-Luxembourg	0.2	–	0.3	–	0.2	–	38.4	3.7
Sweden	2.9	0.5	7.8	1.2	14.7	1.7	15.6	1.5
Canada	14.0	2.6	11.8	1.8	14.0	1.6	7.8	0.8

Note: Data for the United States for 1964 were readjusted for comparability with 1966 on the basis of data given in the *U.N. Yearbook of International Trade Statistics, 1966*. The change involved a reduction in agricultural tractor exports from \$520.8 million to \$394.4 million following a new classification introduced in 1965. Hence data for these two years are not fully comparable with earlier years. The extent to which tractor exports are distorted by the inclusion of construction-type tractors is indicated by the fact that in 1964 only \$188 million of the U.S. total tractor and parts exports were for wheel-type tractors (see U.S. Trade Statistics) and some of these would be industrial tractors.

Source: United Nations, *Commodity Trade Statistics.*

new Ford plant at Antwerp, together with increased exports from the Clayson combine plant after its takeover by New Holland. Italy's share also has been growing rapidly, having risen from 1.4 per cent in 1958 to 4.3 per cent in 1966. The export of Fiat tractors has been a significant element in this growth.

Decline in Canadian-U.S. Share of Non-Tractor Market

In the non-tractor market, the decline in the Canadian-U.S. share has been even more marked than for exports as a whole, having fallen from 63.3 per cent in 1952 to 42.3 per cent in 1966. Britain has also lost ground in this market area, its share having fallen from 15.7 per cent in 1952 to 9.8 per cent in 1966. Major gains in market shares were registered by West Germany with an increase from 8.7 per cent in 1952 to 16.7 per cent in 1966, and by the three smaller countries mentioned above—Belgium, Denmark, and The Netherlands. Their share of this market increased from 2.1 per cent in 1952 to 11.5 per cent in 1966.

TABLE 14.2—WORLD IMPORTS OF FARM MACHINERY, 1966
(Millions of U.S. dollars)

	All Farm Machinery	Tractors: Non-Road	All Other Farm Machinery
Canada	337.3	179.3	157.9
United States	187.4	31.2	156.2
European Economic Community[1]	410.4	187.7	222.7
European Free Trade Association[1]	224.1	98.4	125.7
Other Western Europe	166.0	95.6	70.4
Australia and New Zealand	85.8	67.6	18.2
Japan	15.9	10.6	5.4
Other Asia	88.2	74.9	13.3
Middle East	63.8	44.4	19.4
South Africa	51.0	41.0	10.0
Other Africa	70.4	53.2	17.2
Latin America	158.1	112.4	45.7
Eastern Europe[2]	15.8	2.1	13.7
All other	20.0	14.3	5.7
Total imports	1,894.1	1,012.9	881.3

Note: Data are taken from exports as reported by country of origin.
[1]Includes internal trade within this group of countries.
[2]Imports by eastern European countries exclude trade within this group of countries.
Source: United Nations, *Commodity Trade Statistics.*

There is also some reason to believe that North America has lost some ground in the world market for tractors, especially in the smaller-horsepower sizes. Many of the major North American producers have either acquired production facilities for tractors in Western Europe, or have made arrangements to purchase tractors for sale

under their own brand name from an independent European firm. This development will be discussed more fully below. The data in Table 14.1 do not fully disclose this trend, but they do show a decline in the U.S. share of world tractor exports from 45 per cent in 1964 to 38 per cent in 1966.

On the import side, it is clear that Canada is by far the largest single importer of farm machinery, with imports in 1966 in excess of $300 million. Measured by the total value of imports, Canada is followed in order of importance by the United States, France, and Australia. Over 40 per cent of total imports of farm machinery in 1966 was accounted for by the countries of Western Europe, with the Common Market countries importing about 21.7 per cent of the world total, the European Free Trade Association (EFTA) countries an additional 12 per cent, and the balance of Western Europe about 9 per cent (Table 14.2).

Interregional World Trade Patterns – Some data on the interregional pattern of world trade is given in Table 14.3. The largest *net* exporter of farm machinery is the United States with a balance-of-trade surplus of $441 million in 1966. However, some 80 per cent of this surplus is due to the United States' net export position on tractors alone, and a substantial part of this surplus reflects her exports of tracklaying tractors, many of which are used for construction and other purposes. When tractors are excluded, the U.S. net export position for 1966 was only about $70 million. In terms of the size of the farm machinery trade surplus, the United States is followed by the EFTA countries which had a surplus of some $224 million in 1966. Britain was by far the major exporter in this group with exports in 1966 of $397 million, all but $85 million of which were tractors. Britain's rise to importance in the tractor export picture has been largely a postwar phenomenon and reflects the major production facilities of Ford and Massey-Ferguson. David Brown and British Leyland also have significant exports. Next to Britain in importance in the EFTA group is Sweden with exports of $49 million in 1966. Volvo tractors and combines and Alfa-Laval dairying equipment are the major Swedish exports. For her size, Denmark is also a significant exporter and in 1966 she exported $29 million worth of farm machinery.

The Common Market (EEC) countries, as a group, rank after the United States in terms of total exports, with over $500 million in 1966. However, more than half of the total EEC exports are to other members of that group, and the Common Market's over-all trade surplus in 1966 was just $100 million. Germany, with exports of $224 million was the leader in this group, followed by France with $93 million, Belgium with $86 million, and Italy with $81 million. As discussed below, the growth of the Common Market exports reflects both the location of farm machinery manufacture in that area by a number of the major international companies, and the growth of strong domestic manufacturers such as Deutz and Claas in Germany and Fiat in Italy.

TABLE 14.3 - WORLD EXPORTS OF AGRICULTURAL MACHINERY, BY REGION OR COUNTRY AND BY MACHINERY TYPE, AND BALANCE OF TRADE, 1966

(Millions of U.S. dollars)

	Region or Country of Origin							
Destination	Total	Canada	U.S.A.	EEC	EFTA	Other Western Europe	Japan	Eastern Europe
Total	1,894	161	628	510	497	25	30	28
Canada	337	–	308	12	17	–	–	–
United States	187	151	–	14	21	–	–	–
European Economic Community[1]	410	2	39	270	89	1	2	7
European Free Trade Association[1]	224	2	21	90	105	3	1	2
Other Western Europe[2]	166	–	18	56	78	–	1	13
Australia and New Zealand	86	2	27	8	42	–	3	–
Japan	16	–	7	2	6	–	–	–
Other Asia	88	–	29	6	23	4	18	5
Middle East	64	1	27	10	21	2	1	1
South Africa	51	–	11	6	32	–	2	–
Other Africa	70	–	24	21	21	4	1	–
Latin America	158	3	108	12	31	4	1	1
Eastern Europe[3]	16	–	1	3	5	6	–	n.a.
All other	20	–	9	1	6	0	0	0
Total by type of machinery[4] (S.I.T.C. subgroups)								
712.1 Cultivating machinery	190	36	51	41	43	7	6	1
712.2 Harvesting machinery	560	114	141	211	83	4	1	2
712.3 Dairy machinery	44	1	6	12	23	–	–	–
712.5 Tractors[5]	1,028	8	395	227	334	12	22	24
712.9 Other agricultural machinery	72	1	34	19	14	1	–	–
Balance of trade	–	−177	441	100	274	−141	14	12

[1] Includes internal trade (exports) within this group of countries, taken as original EEC (6) and EFTA (7) member countries.
[2] Other Western Europe consists of Yugoslavia, Iceland, Ireland, Greece, Turkey, Spain, and Finland.
[3] Eastern Europe includes all European countries not otherwise covered. Data on trade between eastern European countries are not available.
[4] Totals of subgroups may not add to total because of rounding.
[5] Tractors include industrial and construction tractors as well as farm tractors.

Source: United Nations, *Commodity Trade Statistics.*

Net Import Position: Canada and Other Countries – The major net importers of farm machinery–listed in order of their trade deficit on farm machinery in 1966– are Canada with a deficit of $177 million, the Latin American Republics as a group with $158 million, other Western Europe countries not included in the EEC and EFTA totals in Table 14.3 (Spain, Greece, Turkey, Yugoslavia, Finland, Iceland, and Ireland) with $141 million, other Asia with $84 million, Australia and New Zealand with $76 million, other Africa with $70 million, and the Middle East with $63 million. Canada is the world's largest net importer of farm machinery. No other single country is remotely close to her in this regard.

Domination of Large International Companies

Over the postwar years, world trade in farm machinery has become dominated to an increasing extent by large international companies such as Massey-Ferguson, Ford, Deere, and International Harvester, which have developed their own marketing and distribution facilities in a growing number of countries. While many of these companies have been involved in an extensive trade in farm machinery for many years, it is only within the past decade that some of them have begun to organize themselves on what may be called a multinational corporate basis. A multinational corporation is one in which national corporations in individual countries are responsible for product development and marketing decisions in their country or region but are subject to the over-all co-ordination of the corporate headquarters. One major company described this development to the Commission as follows:

> The establishment of decentralized marketing and manufacturing activities or the decentralizing of these activities to the market places in which manufacturing and marketing occurred, in other words to the countries in which this occurred, became important when Massey-Ferguson decided that its role was best expressed as that of a multinational company, that is a company that had at its top a small intensive group of generalized staff and specialized staff which was concerned principally with coordination and forward planning, etc., and with progress in the market places of the world, (the major activities of course were those in which we manufactured and in which we controlled the distribution structure down to at least the dealer level). These areas at one time were nine in number and we now operate in 10 countries on this basis. This took place in the area, starting in 1957, it culminated in a major change in organization structure and in organization philosophy–it was announced on November 1, 1959 and therefore it properly dates back to that period. . . . our ability to do this quickly and with a relatively minor amount of rearrangement at the various national or operations unit level was the result of earlier management decisions that were taken, some quite consciously and subjectively, and others as a result of market and investment location influences. We were in France in a strong way and we were in Germany in a relatively strong way, we were definitely located in the United Kingdom, the North American operations were a kind of a common market and our strength was relatively acceptable. We were in Australia and we had acquired a good base in that area, and so forth; for these reasons it became necessary to determine how one could operate a very strong and profitable U.K., French and German, etc., group of operations and yet maintain a structure of North American companies with foreign subsidiaries. This was highly

> unsatisfactory, the response factor alone to changes and management techniques, etc. much too long. Therefore we determined over a period of two years of rationalizing our organizational philosophy that we had to become a multinational company.[2]

As this statement makes clear, it is in considerable part the need to respond quickly to rapidly changing market situations that has made necessary a more decentralized form of corporate organization. In the words of one European executive, "the product life cycle is getting shorter and you may miss the market completely unless you get a new product out on time". This consideration is reinforced by the very marked differences that exist in the agricultural machines required in different areas. The swather which is widely used in Western Canada is used to a much lesser extent in the United States and is scarcely used at all in Western Europe. Hay-mowers in use in North America are not well adapted for use in Europe. Even the type of combine most suitable to one market may have to be changed very substantially to meet the requirements of other markets. In general, North American markets lead the world in their demand for a high level of sophistication in their machinery requirements. Increasingly, too, there has been a demand in many markets for more specialized types of equipment to meet the needs of particular types of farming. It was reported to the Commission that the increasing demand for specialized tractor applications had resulted in the "growth in the number of Ford tractor driveline combinations, based on major options of engine, transmission and rear axle from 24 in 1958 to over 200 in 1966".[3]

This trend towards an increasing number of models and options on different machines may have been one of the factors that influenced some companies to rationalize their operations on a worldwide basis. The Ford Motor Company, which until recently had considerable duplication in its tractor production facilities in Britain and the United States, now has rationalized its tractor production on the following basis. Major components for all Ford tractors are manufactured in three locations–Basildon, England, Antwerp, Belgium, and Highland Park, Michigan. Engines, front axles, and hydraulic units are manufactured in Basildon, 6- and 8-speed transmissions and rear axles in Antwerp, and Selecto 10-speed and 4-speed transmissions in Highland Park. In addition, these three locations have a daily assembly capacity of 300, 125, and 180 tractors, respectively. Tractors are also assembled from varying degrees of "knocked down" conditions at 27 locations throughout the world, in each case out of major components manufactured at these three major locations. As a result of this realignment of production facilities, the same basic tractor models now are sold throughout the world.

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[2] Royal Commission on Farm Machinery, Transcript of Evidence, *Hearings,* Vol. No. 36, January 8, 1968, pp. 3943-4.

[3] Ford Motor Company of Canada, Limited, *Brief to the Royal Commission on Farm Machinery,* Ottawa, November 16, 1967, p. 6.

Similarly, Massey-Ferguson reported that:

> . . . centralized engineering control has brought a degree of MF product standardization and international component interchangeability said to be unrivalled in this or any other manufacturing industry.
>
> Massey-Ferguson, for instance, could take a transmission made in Sao Paulo, an engine manufactured in France, put them with sheet metal parts from England and assemble a tractor to specification in Detroit, . . . [4]

In fact, for all but its largest North American tractors, this company uses diesel engines from England, axles and transmissions from Britain and France, stamped metal from its Toronto works, castings from its "M" Foundry in Brantford, and sheet metal and other components from various local suppliers—with all these components being assembled in its Detroit factory. (It has also begun to develop a similar pattern for the combines which it now produces in five different locations.) It is clear that this trend toward the concentration of the manufacture of components in a few basic locations permits economies of scale that a more dispersed pattern of production would deny.

While Ford and Massey-Ferguson have taken the lead in the trend toward a worldwide centralization of component manufacture, other major companies also have moved to extend the range of their international farm machinery operations. Deere & Company in 1957 acquired the German agricultural equipment manufacturer, A. G. Lanz, and has subsequently established a combine plant at Zweibrücken, a new foundry at Mannheim, Germany, and a new diesel engine plant at Orléans, France. It has also set up production facilities in Argentina and in other parts of the world. This company appears, so far, to be keeping its European and North American operations separate, although the Lanz factory has supplied tractors in the smaller-horsepower range to the Canadian market. During recent years International Harvester has been rationalizing its European manufacturing operations, and by 1967 it was expected to have its combine production concentrated in France, its engine production centralized in Germany and Britain, its tractor transmission production concentrated in France, other key tractor components concentrated in one or two factories, with final tractor assembly taking place in Germany, France, and Britain.

Another pattern has been followed by the White Motor Company, which in recent years has arranged with Fiat to market in North America the Fiat tractor in the smaller-horsepower ranges under the Oliver and Cockshutt brand names. In a somewhat similar pattern, Ford now markets a modified version of the most widely-used European combine, the Claas, in the United States and in Eastern Canada. Again, New Holland, a division of Sperry Rand, markets the Clayson combine under the New Holland name in Canada and the United States, and has recently established a plant in Nebraska which manufactures a combine for the

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[4]Massey-Ferguson Industries Limited, *Brief to the Royal Commission on Farm Machinery*, Ottawa, January, 1968, Vol. I, Ch. II, p. 103.

North American market out of major components imported from Belgium. New Holland, in addition to owning a majority interest in the Clayson plant, has manufacturing facilities in France, England, and Australia.

Position of Local and Regional Manufacturers

In addition to the major international companies which have been moving increasingly towards a pattern of centralized manufacture of major components, especially for combines and tractors, there are in most major markets of the world, manufacturers who concentrate on either local or regional markets. Thus in Sweden, a domestic firm, Bolinder-Munktell (Volvo), is reported to have about 40 per cent of the Swedish tractor market, and exports its tractors and combines throughout Europe and the Middle East. In Italy, Fiat is estimated to have about half the Italian tractor market and exports its tractors throughout Western Europe and to other parts of the world, as well as supplying tractors for North America to the White Motor Company. Similarly, the company of Klöckner-Humboldt-Deutz A.G. is estimated to have about one-fifth of the German tractor market, but also sells extensively in other countries in Western Europe and elsewhere. In addition, it has recently acquired Maschinenfabrik Fahr A.G. a major European manufacturer of combines and other farm equipment. In Western Canada, its tractors are sold by the Canadian Co-operative Implements Limited. C.C.I.L. has also begun to sell the larger Volvo tractors. Renault, a firm partly owned by the French government, has an important position in the French tractor market and also exports, especially to other Common Market countries and to former French colonies. In Canada, its tractors are sold in Quebec by the Coopérative Fédérée de Québec.

From this brief review of recent developments in world markets for farm machinery, three trends are deserving of particular comment. One is the growing importance of the large company that caters to a regional or worldwide market. A second has been the trend towards the concentration of the production of major tractor or machinery components in a single plant, although the final product may be assembled in a number of different locations throughout the world. The third development has been the growing importance of Western Europe as a source of supply for farm machinery in major markets around the world. This latter development has been accompanied by some corresponding decline in North America as a source of supply for world markets.

The growing importance of major companies in both national and international markets undoubtedly reflects the economic advantages that are gained when management, marketing, and engineering and research skills, are spread over a larger volume of total sales. For example, Massey-Ferguson's worldwide sales increased from $21 million in 1939 to $1,043 million in 1969 and this growth must have made possible considerable economies in the use of scarce engineering, research, and management skills.

The trend towards the concentration of tractor component production, and the worldwide standardization of tractor models that has accompanied it, may well reflect the pressure to reduce production costs as tractor manufacturers have begun to produce a wider range of models and options for a market which, in terms of total number, has not been growing in size. According to one estimate, the total number of tractors (810,000) produced in 1966 in non-Communist countries was only slightly more than had been produced 15 years earlier in 1951. The total for the latter year was 777,000.[5] Although the total number of tractors produced in 1966 was lower than in 1951, the total horsepower of tractors produced may well have been double that produced in 1951. However, economies of scale depend largely on the number of units produced and, in the absence of a growth in total numbers, manufacturers have had to seek other methods of gaining economies of scale in order to keep the price of their product in a marketable range. Concentration of component production, together with the disappearance of some smaller producers, has been one of the avenues that the industry has followed to keep unit costs down. Undoubtedly, this move to a more decentralized pattern of component production has been facilitated by improvements in transport and communications. The advent of the jet aircraft and new devices for transmitting engineering designs and specifications has made it easier to co-ordinate and manage manufacturing plants that are scattered around the world.

The shift towards a greater variety of models and more sophisticated equipment has been relatively recent. The Commission was told that: "Only eight years ago Massey-Ferguson made only one tractor similar to the Ford Model "T", one tiller, one tractor, one power train, one anything. We ground them out like hotdogs. There weren't any real concessions made to more sophisticated customer needs."[6] Since that time the industry has moved rapidly towards more variety of models and complexity of product.

Relative Competitive Position: North America and Europe

Cost Factors – The relative competitive position of North American and European producers in world markets reflects a combination of wage costs, productivity, relative exchange rates, tariffs, and other restrictions on trade, and transport costs. When Ford decided to reorganize its tractor production facilities, it chose to build new plants in Basildon, England, and Antwerp, Belgium. This decision may have been influenced in some degree by tariffs in the EFTA and the Common Market, since output from both locations can be shipped into North America on a duty-free basis. But it seems likely that it also reflects a management decision that both Antwerp and Basildon were lower-cost locations for the production of major tractor components than Detroit. Data for average weekly wages in 1965 suggest that wages in Britain are little more than half of those paid in

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[5] Ford Motor Company of Canada Limited, *op. cit.*, data taken from Table 1.
[6] *Hearings, op. cit.*, Vol. No. 36, January 8, 1968, p. 3951.

the United States. Where new production facilities are built and a new labour force is recruited, North American management may well be able to establish productivity levels close to those achieved in North America. Since other basic materials such as steel are as low or lower in most western European countries as they are in the United States, the lower labour costs achieved should give substantially lower over-all costs. For tractors, Commission estimates indicate that production costs at any given volume are about 25 per cent lower in Britain than they are in the United States.[7]

However, productivity levels generally are much lower in Western Europe than they are in the United States, so that even when North American management acquires or builds new production facilities in Western Europe it may often have to accept lower productivity levels than customarily prevail in North America. One company, New Holland, reported to the Commission that taking the productivity in its United States plants to be 100, the comparative productivity of its plants in foreign countries, as measured by the number of man-hours required to do equivalent jobs, was for Belgium, 90, France, 67, England, 63, Australia, 63.[8] They attributed this difference, in very large degree, to the national managerial philosophy in these countries. This philosophy would be reflected in the attitudes of workers, and in the methods used, the way materials were handled, and the layout and tooling of the plant. In some measure, too, lower wage rates may lead to less capital-intensive methods which imply a lower output per worker. However, this adaptation of methods to wage levels does not always occur. In some recently constructed plants, the methods used appear to be as capital intensive as any used in North America. The Commission was told by one Swedish engineer that their company had recently costed three different methods of producing an engine and they had found that the most highly automated method was much the cheapest for a reasonable volume of output.

Recent Expansion Decisions – In assessing the competitive position of various countries in the world market for farm machinery it is useful to examine the recent plant-construction decisions of the major international companies. Because these companies have developed their own distributor and dealer networks in a number of major countries, they are free to plan on supplying these networks from the most economical source, taking into consideration manufacturing costs, tariffs, and transportation costs. However, some emphasis must also be given to what one witness described as the intangible advantage of having production facilities in your major market areas.

An examination of decisions with respect to the location of new manufacturing facilities in recent years by seven major North American companies suggests that Western Europe has been a favoured location. As Table 14.4 shows, over the

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[7] Royal Commission on Farm Machinery, *Special Report on Prices of Tractors and Combines in Canada and Other Countries* (Ottawa: Queen's Printer, December 1969), pp. 66-72.

[8] New Holland Division of Sperry Rand Corporation, New Holland, Pennsylvania, U.S.A., *Brief to the Royal Commission on Farm Machinery*, Ottawa, November 15, 1967, p. 4.

period 1955-67, in terms of square footage, some 41 per cent of new production facilities has been located in Western Europe, of which 26 per cent was in the EEC (mainly in Belgium, France, and West Germany) and 15 per cent in the EFTA countries, mainly in Britain. New facilities in United States were almost the same in total area as those in Western Europe—about 40 per cent of the total. Data are fairly approximate and for most countries include facilities built for the manufacture of light industrial equipment as well as farm machinery. Canada received about 7 per cent of the total and Latin America about 9 per cent.

TABLE 14.4—INCREASES IN MANUFACTURING PLANT CAPACITY FOR MAJOR NORTH AMERICAN FARM MACHINERY MANUFACTURERS, BY COUNTRY OR REGION, 1955-67

	Total Increase in Capacity ('000 sq. ft.)	Percentage of Total
Canada	1,059	7
United States	6,213	40
European Economic Community	4,034	26
European Free Trade Association	2,329	15
Latin America	1,370	9
Australia	157	1
India	89	1
South Africa	178	1
Total	15,429	100

Note: Data for most firms included manufacturing space devoted to light industrial equipment as well as farm machinery. While some companies reported manufacturing space only, others included administrative office space adjacent to manufacturing facilities as well.
Source: Data were provided by the following companies: Case, Deere, Ford, International Harvester, Massey-Ferguson, New Holland, and White Motor.

Tariff Rates – In some measure this recent concentration of new plant construction in Western Europe reflects the expanded market opportunities opened up by the creation of the European Common Market and the European Free Trade Association. While tariffs on agricultural machinery are moderate in comparison to tariffs on some products, they are still high enough to have a significant effect on plant location decisions. This is particularly true when one considers not just nominal tariff rates but the effective protection offered to the total farm machinery manufacturing operation, with full allowance for the level of tariffs on the raw materials or components used by the industry.

A recent study has estimated effective tariff rates for farm machinery in a number of important countries or areas. As the data in Table 14.5 show, effective tariff rates on farm machinery production in Britain, Sweden, and the Common Market are appreciably higher than nominal rates would indicate. In contrast, in the United States, because manufacturers may have to pay tariff duties on imported materials while receiving little or no protection on their final product, the effective tariff rate is negative.

TABLE 14.5–NOMINAL AND EFFECTIVE TARIFF RATES ON FARM MACHINERY, SELECTED COUNTRIES, 1962

	Nominal Tariff Rate	Effective Tariff Rate
	(Per cent)	(Per cent)
United States	0.4	–6.9
Britain	15.4	21.3
Sweden	10.0	16.0
Japan	20.0	29.2
European Economic Community	13.4	19.6

Source: Bela Belassa, "Tariff Protection in Industrial Countries: An Evaluation", *Journal of Political Economy*, December 1965.

Because tariff regulations are usually complex and often vary with the size and type of machine, it is difficult to summarize in concise fashion the tariffs that are in effect on different products. However, an unweighted average of tariff rates applying in the major western European countries is given in Table 14.6. These averages are based on tariff rates that were in effect about the time the European Common Market was formed.

TABLE 14.6–AVERAGE TARIFF RATES ON AGRICULTURAL MACHINERY AND TRACTORS, WESTERN EUROPE, 1957-59

	Agricultural Machinery	Tractors
Austria	19	22
Denmark	5	2
Norway	9	0
Portugal	13	2
Sweden	10	10
Switzerland	8	11
Britain	14	15
Benelux	7	15
France	16	22
Germany	5	7
Italy	20	27
European Economic Community	11	20

Source: *Atlantic Tariffs and Trade*, Political and Economic Planning, London, 1962.

Both of the above sets of tariff data suggest that tariff rates among both the Common Market and EFTA groups are high enough to give a significant advantage to farm machinery manufacturers producing inside the tariff barrier. As a result of the Kennedy Round trade negotiations, the Common Market tariff on a wide range of farm machinery and harvesting equipment will decline by January 1st, 1972, from 9 to 4.5 per cent. Common Market tariffs on agricultural tractors will remain unchanged at about 18 per cent. In Britain, on the same date, tariffs on

agricultural tractors will decline from 15 to 7.5 per cent and tariffs on other farm machinery which now range from 10 to 14 per cent will fall to from 6 to 7.5 per cent.

Credit Availability and Foreign Aid – International trade in farm machinery is affected not only by tariffs but also by credit arrangements and by various forms of foreign aid. In respect to credit it was argued before the Commission that the credit support available to Canadian manufacturers is much less generous than that available to manufacturers of farm machinery in many other parts of the world. In the words of one manufacturer, "If Chile can get ten years' credit with no down payment from three different countries in Europe and one Iron Curtain country she will not buy on four-year-credit limit from Canada. You just can't sell under those circumstances, and certainly no private enterprise should be asked to take those kinds of credit risks when in all other parts of the world governments are underwriting these commercial transactions."[9]

However, officials of the Department of Industry, Trade and Commerce advise that the situations suggested by Mr. Staiger are relatively rare. Farm machinery is sold internationally against cash or short-term credit to developed countries and on short- to medium-term credit, mostly two to three years, to developing countries. Where governments buy sizable quantities for resale to farmers, credit may be extended up to five years. Longer-term credit is sometimes provided where the sale of farm machinery is part of a much larger development project.

The Canadian Government's policy is to support exports through insurance, credit guarantees, or long-term loans on a basis that matches the support provided by other governments, but not to exceed it. Information is provided to the Canadian Government by foreign government export credit and insurance agencies through the "Berne Union" so that Canada is aware of the credit terms provided on most export sales. Since Canada is a net importer of capital, it is considered undesirable that she become involved in a credit-granting contest as a basis for promoting export sales.

An examination of data on the relation between aid programs and exports of agricultural machinery for the United States, Britain, and a number of European countries, suggests that aid-financed exports are a significant and growing portion of farm machinery exports. Between 1962 and 1965 aid-financed exports of agricultural machinery from the United States have risen from 1.8 per cent to 5.6 per cent of total U.S. exports of this commodity. Moreover, by 1965, some

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[9] *Hearings, op. cit.*, Vol. No. 36, January 8, 1968, pp. 3970-71.

two-thirds of U.S. exports of agricultural machinery to a selected group of Asian and African countries was aid-financed. The equivalent percentage for six Latin American countries was 45. For Britain, aid-financed exports amounted to 2.1 per cent of her total exports of agricultural machinery in 1964, 2.3 per cent in 1965, and 3.7 per cent in 1966.

Farm machinery is eligible for support under Canadian aid programs. However, aid-supported export sales have been relatively small. The reasons for this are varied. Canada produces very few tractors–the farm machine most frequently requested. Further, even for machines produced in Canada, such as combines, one of the principal Canadian producers, Massey-Ferguson, has extensive production facilities in Western Europe and may often prefer to supply requests for combines under aid programs from one of her three European plants. Even when the original shipment comes from Canada the follow-up may be from a plant outside of Canada. However, these arguments do not apply to companies such as Cockshutt and Versatile, which produce all their combines in Canada.

Ocean Transportation – Canada's participation in world trade in farm machinery is significantly affected by ocean transport rates. However, the effects of these rates on trade is difficult to summarize precisely, because rates vary significantly, depending on whether tractors or other farm machines are shipped packed or unpacked, and on whether the machines are shipped under general conference rates or under negotiated contract rates. The latter are available whenever a manufacturer ships to a given destination in substantial volume. Conference rates usually reflect the volume of traffic moving between any two points, and are generally lower for shipments from Europe to North America than for the reverse movement from North America to Europe. This reflects the large movement of grain and other bulky commodities eastward across the Atlantic Ocean which creates a demand for back-haul cargo. Rates on packed machines are generally lower, often less than half, than those on unpacked machines. Tractors moving from Britain to Canada are an exception. Here, the packed rate is higher than the rate on unpacked machines.

Table 14.7 provides estimated ocean freight charges between a number of major points throughout the world for a Ford 5000 (56 HP) diesel tractor. The data suggest that for packed shipments, tractors can move across the Atlantic from North America almost as cheaply as they move in the reverse direction. However, freight costs from Britain to Canada on an unpacked basis are especially low. For shipments to more distant points such as Australia and South Africa, Europe appears to have some freight advantage over North America, particularly on packed shipments. In addition, Table 14.8 provides detailed data on ocean freight costs on averaged-sized tractors in different horsepower categories between Britain and Montreal.

TABLE 14.7–OCEAN SHIPPING COSTS FOR FORD 5000 8-SPEED TRACTOR SHIPPED UNPACKED/PACKED BETWEEN VARIOUS LOCATIONS, MID-1967 OR MID-1968 GENERAL OCEAN FREIGHT RATES

(Canadian dollars)

	Shipped to													
	Montreal, Canada		Hamilton, Canada		Britain		Bordeaux/Hamburg Range		Italy		South Africa		Australia	
Shipped From	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]	Un-packed[1]	Packed[2]
North America														
Montreal, Canada		–			337	151	378	163	438	198	344	183	344	240
Hamilton, Canada			–		364	161	379	171	456	208			353	252
Detroit, United States					282	154	294	161						
Europe														
Britain	140	180	150		–						261	155	347	160
Bordeaux/Hamburg Range	369	219	380	225			–						347	161
Italy	519	307	–						–				530	285
Sweden	279	185	300	198							281	164	328	237

Note: Amounts include loading charges and Seaway tolls. General freight rates (open to the public) are usually much higher than contract rates from continental Europe to Canada.

[1] Measurements, from product specification sheets: Weight: 5,524 lbs. or 2,506 kilograms. Volume: 343 cubic feet or 9.71 cubic metres.

[2] Measurements:

	Pounds	Kilograms
Tare weight (est.)	800	363
Net weight	5,524	2,506
Gross weight	6,324	2,869
Volume-packed (est.)	ca. 200 cu. ft.	= 5.7 cubic metres
	5 cu. tons (ea. 40 cu. ft.)	

Source: Freight rates secured from various applicable shipping conference rate schedules or direct quotations from shipping lines offering service to areas.

TABLE 14.8 FREIGHT COSTS FOR UNPACKED TRACTORS OF DIFFERENT SIZES SHIPPED BETWEEN CANADA AND BRITAIN, MID-1967 OR MID-1968 GENERAL FREIGHT RATES

(Canadian dollars)

PTO Horsepower Group	Volume Freight Units (40 cubic feet)	Weight (lbs.)	Shipped From:	Shipped to: Montreal Canada	Britain
Under 45	6.2	3,600	Montreal		243
			Britain	101	
45-60	8.8	5,100	Montreal		346
			Britain	144	
60-75	9.1	5,700	Montreal		358
			Britain	149	
90-100	16.0	8,900	Montreal		625
			Britain	258	
Over 100	19.6	14,500	Montreal		765
			Britain	315	

Note: Typical dimensions and weights of tractors in each horsepower group used with freight rates from applicable shipping conference rate schedules, or direct quotations from shipping lines. Amounts include loading charges and Seaway tolls. General freight rates (open to the public), are usually much higher than contract rates from continental Europe to Canada.

Source: Commission estimates based on data noted above.

Ocean freight charges on combines (shipped packed) between Europe and North America range between $1,300 and $1,700 per combine. However, contract rates lower shipping costs dramatically. New Holland estimated their cost of bringing combines from Belgium to North America at $400 per unit. Another firm reported shipping costs from continental Europe to Canada of $600. No data are available on contract rates for shipments from Canada to other countries. Since prices of combines are very significantly lower in Western Europe than they are in Canada, it seems unlikely that there will be any substantial export of combines from Canada to Western Europe. Versatile's much lower-priced combine could be an exception to this pattern. However, if Versatile desires to export to Europe or elsewhere throughout the world, it will be faced with the problem of building up a reliable repair parts distribution facility in the countries it wishes to supply.

Chapter 15

THE PATTERN OF TRADE BETWEEN CANADA AND THE UNITED STATES AND BETWEEN CANADA AND OTHER COUNTRIES

At an early stage in its development, the farm machinery industry in Canada acquired a significant export trade. In 1887, one of the leading Canadian manufacturers, the Massey Company, set up sales agencies in South America, England, continental Europe, and Australia. They were soon followed in this enterprise by the Harris Company and when these two companies merged in 1891 their export business was consolidated and continued to prosper. Some data showing the pattern of this trade during the pre-Second-World-War period are given in Table 15.1. By the early 1900s Canada was already exporting close to $2 million worth of farm machinery, with significant markets in Australia, Britain, Germany, and France. By the late twenties Argentina had become Canada's leading export market, taking some $3.8 million worth of farm machinery annually. Following the removal of the U.S. tariff in 1913, exports to that country increased also and by the late twenties the United States had become Canada's second most important market, taking about 23 per cent of her total exports. Significant new markets had also been developed in South Africa and Russia, and total exports of farm machinery reached a pre-Second-World-War peak of $20.1 million in 1929. As a result of higher tariffs, the Great Depression, and political factors, Canada's exports to Germany, Russia, and France had all but disappeared by the late thirties. However, exports to South Africa, Argentina, and the United States were fairly well sustained, and exports to the United Kingdom even increased. On a commodity basis, Canada's early export trade centred around the binder and a few other implements. In 1914, for example, Canada's $7.3 million worth of exports included $3.1 million in binders, $.9 million in mowers, $680,000 in drills, and $450,000 in plows. Throughout this period, Massey-Harris was by far the most important firm on the export side.

The farm machinery industry has often been cited by economists as an example of the results that can be expected from a free-trade arrangement between Canada and the United States. The U.S. tariff on farm machinery was removed in 1913, and after a number of "ups and downs" the Canadian tariff was removed in 1944. In examining the effects of these changes it is useful to look both at what happened to total trade between Canada and the United States and to its impact

TABLE 15.1–CANADIAN EXPORTS OF FARM MACHINERY, BY COUNTRY: THE HISTORICAL PATTERN

	Annual Averages ($'000)		
	1900-03	1926-30	1937-39
Total to all countries	1,891	16,190	8,201
United Kingdom	419	579	1,340
France	226	1,636	85
Russia	58	1,040	–
Germany	354	426	13
Argentina	36	3,823	1,915
Australasia	644	1,890	499
South Africa	24	1,149	1,068
United States	28	3,750	2,510
All others	101	1,897	771
	Percentage		
Total to all countries	100.0	100.0	100.0
United Kingdom	22.4	3.6	17.0
France	12.1	10.1	1.1
Russia	3.2	6.4	–
Germany	19.4	2.6	.1
Argentina	1.9	23.6	23.0
Australasia	33.3	11.7	6.1
South Africa	1.1	7.1	13.0
United States	1.4	23.2	30.2
All others	5.1	11.7	9.4

Note: Data are averages of fiscal years and do not include re-exports. Percentages and dollar amounts may not add due to rounding.

Source: Dominion Bureau of Statistics, *Trade of Canada*, various years.

upon individual companies. Even before the U.S. tariff was removed the threat of reciprocity between Canada and the United States had caused Massey-Harris to acquire the Johnston Harvester Company in Batavia, New York, in 1910. At the time, this company with its American distribution network represented a valuable addition for Massey, but, in the end, as the centre of the market shifted westward it proved an uneconomic production location and the factory was closed down.

Prior to the removal of the U.S. tariff, Canadian exports of farm machinery to the United States were almost non-existent. For the period 1900 to 1903 they averaged only $28,000 or about 1.5 per cent of total Canadian farm machinery exports. However, after the tariff was removed there was an appreciable rise in Canadian exports to the United States. They reached $1.3 million in 1922-23 and $4.4 million in 1928-29. For the period 1926 to 1930 as a whole, the American market took 23.4 per cent of Canadian exports. Nevertheless, when one considers the size and proximity of the market it is surprising that it was not even more important. Canada's exports of farm machinery to the United States in this period were slightly less than her exports to Argentina.

Some evidence as to why exports to the United States were not more extensive was given by executives of Massey-Harris, testifying before a House of Commons Committee in the 1930s. The President of the company stated that he would be unwilling to attempt to develop a market in the United States that was heavily dependent on Canadian production. He argued that American farmers had a prejudice against imported equipment, and, in addition, there was always the risk that the tariff would be reimposed. For these reasons, although Massey-Harris was making a major effort to increase their penetration of the U.S. market at the time, they also took steps to acquire additional production facilities in the United States. In the same testimony the President stated that Massey could compete on equal terms with American producers in the Argentine market but not in the United States.

During the same hearings the President of International Harvester reported that very little of their Canadian production was exported to the United States. Because of their U.S. company's larger volume, he contended, its production costs were lower. He appeared to have never considered concentrating certain lines in the Canadian plant in order to achieve a large volume low-cost operation. The other major American producer, John Deere, had acquired a small plant at Welland when it took over Dain and Company, an American producer of mowers. However, this plant was closed down completely in 1926 and remained closed until 1932. In 1924 the Canadian tariff had been reduced from 10 to 6 per cent on harvesting machinery, from 12.5 to 7.5 per cent on tillage equipment, and from 15 to 10 per cent on plows. Following the increase in the tariff to 25 per cent on all farm machinery except tractors in September 1930, Deere's sales in Canada fell sharply. Deere's Canadian sales in 1931 were little more than one-tenth of their 1930 level and only about 5 per cent of their 1929 level. The Welland plant was reopened in 1932 and by the mid-thirties was producing an extensive range of farm equipment, including binders, plows, field cultivators, disk harrows, spring- and spike-tooth harrows, seed drills, and disk tillers. However, out of this long list of products only the disk tiller was shipped into the U.S. market. It seems clear that in this period the Deere Company never seriously examined the possibility of using its Canadian plant as a source for any important part of its U.S. market. Indeed, if it had not been for the tariff imposed in 1930, and the expansion of manufacturing operations it induced, Deere might well have abandoned manufacturing operations in Canada permanently.

Prior to 1944, the other major Canadian producer of farm machinery, Cockshutt, had apparently not attempted to develop an extensive market for its line of equipment in the United States. For a short period in the mid-twenties they sold several hundred stiff-toothed cultivators in Montana, after sending a number out in response to a request from an agricultural college. However, once American firms started producing a similar product, this market gradually disappeared. Cockshutt's unsuccessful attempt to build up its American market after 1945 is described elsewhere in this Report (see Chapter 4).

Thus, before the Second World War, although United States had become a significant market for Canadian farm machinery, the Canadian industry still sold its products in many other countries throughout the world, including the United Kingdom, Argentina, South Africa, Australia, and New Zealand. In the late thirties the United States took about 30 per cent of Canadian farm machinery exports, compared with 70 per cent for all other countries. Since 1945, however, there has been a steady decline in Canadian exports to countries other than the United States (see Table 15.2). Indeed, by 1967 all but 5 per cent of Canada's exports of farm machinery were being shipped to the United States. While Canada's exports to all other countries were only $2.2 million less in current dollars than their average level from 1926 to 1930, they were probably not more than one-third of their earlier level in dollars at constant prices. Given the very large growth that has occurred in farm machinery markets throughout the world, the decline in Canadian exports to these countries has been very marked indeed. In contrast, except for a decline during the market slump in the mid-fifties, there has been a steady growth in Canadian exports to the United States, and they reached a peak of $184 million in 1967.

TABLE 15.2–CANADIAN EXPORTS OF FARM MACHINERY TO UNITED STATES AND ALL OTHER COUNTRIES, SELECTED YEARS, 1900-69

	Total	United States	All Other	United States	All Other
		(Millions of dollars)		(Per cent)	
1900-03	1.9	.0[1]	1.9	1.4	98.6
1910-14	5.9	.1	5.8	1.7	98.3
1922-23	5.7	1.0	4.8	16.3	83.7
1926-30	16.2	3.8	12.4	23.0	77.0
1937-39	8.2	2.5	5.7	30.2	69.8
1945-47	32.7	17.8	14.9	52.1	47.9
1948-52	95.8	73.9	21.9	76.9	23.1
1953-57	71.6	56.6	15.0	79.2	20.8
1958-62	95.7	88.2	7.5	92.0	8.0
1963-67	159.5	146.8	12.7	91.8	8.2
1967	194.3	184.1	10.2	94.8	5.2
1968	168.5	158.4	10.1	94.0	6.0
1969	180.5	170.9	9.6	94.7	5.3

Note: Above data do not include re-exports. See Table A.5 for net trade balance between Canada and World including re-exports.

[1] Actually $30,000.

Source: Based on data from Dominion Bureau of Statistics, *Trade of Canada, Exports by Commodities,* Cat. No. 65-004 (Ottawa: Queen's Printer), various years, 1900-69.

Although difficult to explain completely, this sharp realignment in the pattern of Canadian farm machinery exports appears to be due to a number of factors. Following the removal of the Canadian tariff in 1944, the major manufacturing firms in Canada gradually reorganized their plants so they became specialized for the production of certain implements for the entire North American

market. At the same time, restrictions in the sterling area against imports from the dollar area and other countries cut off or restricted a number of Canada's important prewar markets. For a short period following the Second World War exports of farm machinery were supported by various aid and loan programs, and between 1948 and 1952 Canadian exports to countries outside the United States averaged around $22 million annually. But as the amount of aid tapered off and domestic output in Western Europe recovered, exports to these areas declined. Postwar tariff reductions also reduced the importance of Commonwealth preferences for farm machinery. Further, tariffs and other restrictions limited Canadian access to other prewar markets, as countries such as Argentina, Brazil, and Australia attempted to foster growth in the manufacturing of their own agricultural implements.

Another significant development–in part a reflection of the above restrictions–was the change in the character of Massey-Harris' operations from a company that relied mainly on its Canadian manufacturing operations to supply markets throughout the world to an international company with its own manufacturing operations in a large number of different countries. This has meant that markets which Massey formerly supplied from Canada can now be supplied from plants within their own country, as is the case in the United Kingdom or South Africa, or from plants in a nearby country. Massey had already acquired a plant in France and one in Germany in the mid-twenties but these were relatively modest operations compared with the company's present international facilities (for a detailed description of some of these changes see Chapter 4).

Another development that may have adversely affected the ability of Canadian farm machinery to compete abroad has been the increasing sophistication and size of the equipment now demanded in the North American market. This has meant that equipment suited to Canadian farm needs may be too large or advanced for many other countries. Still, many of the newer developments, such as power steering and advanced types of transmissions, take the form of options that can be left off the smaller machines shipped to less-advanced markets.

In view of the decline that has occurred in Canada's exports of farm machinery to countries other than the United States, it is useful to compare Canada's trade outside North America with that of the United States. Such a comparison for 1966 is provided by the data in Table 15.3, which show Canadian exports of farm machinery, by type of machinery and destination, as a percentage of U.S. exports. These data indicate that Canada has a much smaller share of exports to these third market areas than she has for total exports. As the final two columns of this table show, Canadian exports to third markets are only 3.3 per cent of U.S. exports compared with 26.4 per cent for the total export trade. If tractors are excluded, the comparable figures are 14.5 per cent and 71.7 per cent. Further, this difference exists for virtually every category of machinery to every destination. Since Canadian manufacturing plants are on the

TABLE 15.3–CANADIAN EXPORTS AS PERCENTAGE OF U.S. EXPORTS, AGRICULTURAL MACHINERY, BY TYPE OF MACHINE AND DESTINATION, 1966

	Standard International Trade Classification	European Economic Community	European Free Trade Association	Other Western Europe	Australia and New Zealand	Japan	Middle East	Other Africa	Latin America	All Countries	All Countries Except U.S. and Canada
Agricultural Machinery	712.0	4.7	7.5	1.4	8.3	4.5	2.1	7.4	2.4	26.4	3.3
Cultivating machinery	712.1	—	24.2	—	23.7	—	35.2	—	4.1	70.7	8.1
Harvesting machinery	712.2	16.8	19.3	5.8	31.3	34.5	—	—	15.7	81.5	15.7
Dairy machinery	712.3	—	56.4	—	—	—	—	—	—	21.5	12.4
Tractors	712.5	.5	—	—	2.4	—	—	—	.2	2.0	.4
Other agricultural machinery	712.9	—	—	—	—	—	—	—	—	1.8	.4
Total, excl. tractors		11.2	18.2	4.6	26.6	12.8	11.2	4.9	8.8	71.7	14.5

Source: United Nations, *Commodity Trade Statistics.*

average closer to ocean transport than those in the United States, it seems clear that this difference must be due to other than strictly economic considerations.

Table 15.4 provides some historical perspective on Canada's share of the total farm machinery exports to third markets by Canada and the United States combined. It shows a significant decline in Canadian exports to the rest of the world relative to those of the United States. In the period from 1928 to 1930, the Canadian share was about 14 per cent; in the period 1946 to 1948 it was 15 per cent; and by 1964 to 1966 it had fallen to 8.5 per cent.

TABLE 15.4–CANADIAN AND U.S. EXPORTS OF FARM MACHINERY TO THE REST OF THE WORLD (EXCLUDING CANADA AND UNITED STATES), SELECTED YEARS, 1928-69

	Canadian Exports	U.S. Exports	Total United States and Canada	Canada's Share of Total
	(Millions of Canadian dollars)			(Per cent)
1928	12.1	65.1	77.2	15.7
1929	11.5	93.4	104.9	11.0
1930	14.3	79.9	94.2	15.2
1937	4.4	39.2	43.6	10.1
1938	7.0	38.4	45.4	15.4
1939	4.7	32.3	37.0	12.7
1946	14.3	56.6	70.9	20.2
1947	19.0	122.4	141.4	13.4
1948	24.4	177.3	201.7	12.1
1953	16.0	108.4	124.4	12.9
1954	23.6	136.8	160.4	14.7
1955	12.7	123.7	136.4	9.3
1963	10.0	129.6	139.6	7.2
1964	13.0	198.0	211.0	6.2
1965	19.6	157.7	177.3	11.1
1966	10.9	122.3	133.2	8.2
1967	10.2	139.3	149.5	6.8
1968	10.1	149.6	159.7	6.3
1969	9.6	158.5	168.1	5.7

Note: U.S. dollars converted to Canadian currency at applicable Bank of Canada rates.

Source: Foreign Commerce and Navigation of the United States, *U.S. Exports of Domestic Produce,* FT 410; Dominion Bureau of Statistics, *Trade of Canada,* various years.

The further rise in Canadian exports to the United States during the past few years reflects a number of factors. The devaluation of the Canadian dollar which culminated in the return to a fixed rate in June 1962 undoubtedly made Canadian plants more competitive in the North American market. In addition, Massey-Ferguson, a firm that concentrates a major share of its North American production in Canada, has recently been making a concerted effort to increase its share of the U.S. market. Any success it experiences in this endeavour is likely to be paralleled by a rise in Canadian exports to the United States. Further, after

Cockshutt was acquired by the White Motor Corporation in 1962 its manufacturing operations were changed from that of a full-line company selling a broad range of products to a plant specializing in the production of combines for the North American market. This change must have been reflected in an increase in Canadian exports to the United States.

The decline in Canadian exports to countries outside North America has also been paralleled by an increase in imports of farm machinery from Western Europe (see Table 15.5). Until comparatively recently, imports from Western Europe had rarely supplied more than 4 per cent of Canada's total imports of farm machinery. However, during the past decade Europe's share has risen significantly, reaching 6.8 per cent in 1964 and 9.6 per cent in 1967. Imports of tractors and tractor parts have been a major factor in this growth, and it reflects the increasing competitive strength of the European-produced tractor. In 1967, Western Europe supplied 14 per cent of Canada's total tractor imports. Moreover, these data may understate the importance of Europe as a source, since Canadian imports of Massey-Ferguson tractors from the United States contain a significant European content.

TABLE 15.5–CANADIAN IMPORTS OF FARM MACHINERY: FROM ALL COUNTRIES, FROM UNITED STATES, AND FROM WESTERN EUROPE, SELECTED YEARS, 1929-67

	Total (All Countries)	United States	Western Europe	United States	Western Europe
	(Millions of dollars)			(Per cent)	
1929	40.3	39.8	.6	98.8	.7
1939	20.9	20.1	.8	96.1	3.9
1952	197.3	190.1	7.1	96.4	3.6
1958	198.3	189.9	8.2	95.8	4.1
1964	330.1	307.2	22.5	93.1	6.8
1967	418.4	377.7	40.4	90.3	9.6

Source: Dominion Bureau of Statistics, *Trade of Canada*, various years.

The growing importance of Western Europe as a source of imports of farm machinery has also been reflected in the pattern of U.S. trade. Thus, as the data in Table 15.6 show, Western Europe now supplies about 16 per cent of all farm machinery imported by the United States compared with only 3.4 per cent in 1952. All of this increase in the European share of the U.S. market had occurred by 1958, and there has been little change in the relative position of Canada and Western Europe over the past decade. Still there have been divergent trends for different product groups. The western European share of total U.S. imports of harvesting equipment has risen from .3 per cent in 1958 to 5.5 per cent in 1967, and its share of all other machinery has risen from 5.2 per cent in 1958 to 10.6 per cent in 1967. In contrast, for tractors and parts, the Canadian share of U.S.

imports rose from 23.5 per cent in 1964 to 42.0 per cent in 1967, whereas during the same period the western European share fell from 75.8 per cent to 56.5 per cent. Canadian exports in this category include crawler tractors manufactured by International Harvester in Hamilton and tractor parts which are supplied from Brantford and Toronto to Massey-Ferguson's tractor plant in Detroit. The improved competitive position of Canadian-sourced supplies as a result of the devaluation of the Canadian dollar in the early sixties may well explain this recent shift. The rapidly increasing importance of the larger-horsepower tractors which are not manufactured in Europe has been a contributing factor to the decline in the relative importance of imports from Western Europe.

TABLE 15.6–U.S. IMPORTS OF FARM MACHINERY, BY COUNTRY OF ORIGIN, SELECTED YEARS, 1952-67

	1952	1958	1964	1967
	(Millions of U.S. dollars)			
From all countries				
Total	98.2	122.1	173.3	266.6
Combines, harvesters, and parts	41.4	53.0	97.7	151.9
Tractors and parts	15.2	29.3	29.4	50.6
All others	41.6	39.8	46.2	64.1
From Canada				
Total	94.5	99.8	145.1	221.1
Combines, harvesters, and parts	41.2	52.8	96.2	142.7
Tractors and parts	13.7	9.9	6.9	21.2
All others	39.6	37.1	42.0	57.1
From Western Europe				
Total	3.3	21.5	27.4	43.8
Combines, harvesters, and parts	.1	.2	1.2	8.4
Tractors and parts	1.5	19.3	22.3	28.6
All others	1.7	2.1	3.8	6.8
	(Percentage of total imports)			
Total farm machinery				
Canada	96.2	81.7	83.7	82.9
Western Europe	3.4	17.6	15.8	16.4
Combines, harvesters, and parts				
Canada	99.7	99.7	98.5	93.9
Western Europe	.3	.3	1.3	5.5
Tractors and parts				
Canada	89.9	33.9	23.5	42.0
Western Europe	9.9	65.9	75.8	56.5
All other farm machinery				
Canada	95.0	93.0	90.9	89.0
Western Europe	4.0	5.2	8.2	10.6

Source: United States, *Imports of Merchandise for Consumption*, various years.

Although total U.S. exports of wheeled agricultural tractors have been declining in dollar terms in recent years, American firms have remained competitive in this market over the past two decades, largely through their development of more sophisticated larger-horsepower tractors. Total U.S. exports of wheeled farm tractors and parts increased 11 per cent from 1964 to 1967, rising from $188 million to $208 million. Moreover, the average size of tractor exported has risen steadily. Whereas 42 per cent of U.S. agricultural tractor exports were under 35 HP in size in 1952, 75 per cent were over 60 HP and almost one-third were over 90 HP in 1967. Less than 3 per cent were in the under-35-HP category. A similar rise in horsepower size has been evident in U.S. exports of tracklaying and wheel-type construction tractors. Almost 80 per cent of U.S. exports of agricultural tractors go to Canada, Australia, and New Zealand—countries where larger farms and the use of larger tractors are most prevalent. Some details of these changes are provided in Table 15.7.

TABLE 15.7–U.S. EXPORTS OF TRACTORS, BY TYPE AND SIZE, 1952, 1964, AND 1967

(Excluding contractors off-highway wheeled tractors)

(Millions of U.S. dollars)

	1952	1964	1967
Wheeled agricultural tractors and parts			
(Less parts and used machinery)	95.0	131.9	137.0
(Including parts and used machinery)	123.5	188.1	207.7
All other tractors and parts (tracklaying, wheel-type, construction and garden)	165.5	359.1	354.5[1]
Total tractor and parts (including used)	289.0	547.2	562.2
Wheeled agricultural tractors, by size:			
Under 35 HP	39.6	6.1	3.7
Over 35 HP	55.4	125.8	133.3
35-60 HP	n.a.	39.1	32.4
Over 60 HP	n.a.	86.7	100.9
60-90 HP	n.a.	n.a.	57.2
90 HP and over	n.a.	n.a.	43.7
Used machinery parts	28.5	56.2	70.7

[1]Includes parts and accessories for contractors off-highway wheeled tractors, but not the tractors themselves totalling $44.4 million.

Source: U.S. Exports, Schedule B Commodity and Country, FT 410, December 1967; Foreign Commerce and Navigation of the United States, Exports of Domestic Merchandise by Schedule B Commodity, 1958 to 1964, Table 11; Foreign Commerce and Navigation of the United States, Exports of Domestic Merchandise by Schedule B Commodity, 1952.

While Canada has allowed duty-free import of farm machinery since 1944, and the U.S. tariff was removed in 1913, there are some exceptions and some differences in treatment for each tariff. In 1963 the U.S. Customs Act was revised and, as a result, the U.S. treatment of a few machines and components became more restrictive. Canada makes use of "end-use" certificates which eliminate duties and taxes over broad ranges of products for certain user categories–in this case, farmers. Until 1963, the United States relied on "chief use" categories which exempted items from duty if it could be shown that their major use was limited to a category entitled to an exemption. Under these arrangements major farm machines generally entered both countries duty-free. Parts for use in the manufacture or repair of farm machines also moved freely, on submission of an end-use certificate in Canada, or on determination of their sole or chief use in agriculture in the United States. In addition, Canada allowed manufacturers of farm machines to import all raw materials duty-free, as well as machine tools used exclusively in the manufacture of farm machines. Both of these items are dutiable going into the United States. Perhaps the major difference in treatment between the two tariffs has been with respect to tractors. Both farm and industrial tractors can be imported into Canada duty-free. For the United States only farm tractors are duty-free. On other tractors there was a duty of 11.5 per cent. As a result of the Kennedy Round trade negotiations under the General Agreement on Tariffs and Trade (GATT) this will drop to 5.5 per cent by January 1, 1972.

In 1963 the United States undertook a major technical revision of its whole tariff structure. The intention of this revision was to clarify ambiguities and simplify the tariff's administration. In the revision, two principles were firmly established. One principle was that of specifically naming and grouping all similar items under common classifications, with subheads to identify component parts of the group which might differ in some way. Thus all bearings would be grouped together, with ball bearings, roller bearings and needle bearings forming subgroups. The second principle was that of removing general exemptions for certain "chief uses". In place of these exemptions the U.S. tariff set out to describe everything under separate categories. Exceptions were to be noted under each category. The precise description and categorization did not cause problems. But the question of exemptions did.

For example, in the field of agricultural machinery, a general exemption had applied to parts used in its production. For farm machinery manufacturers, custom-made parts, manufactured to their own designs, had been automatically duty-free under the earlier arrangements because their chief use was their only use–as parts for the manufacture of farm machines. Quite a substantial export business had developed from Canada of parts used in the manufacture of farm machines.

Although Canadian trade officials had anticipated the possible effects of the new U.S. tariff structure, U.S. officials were not prepared to provide the changes in their basic system of completely separate classifications on which the

new tariff had been drawn up, or to insert the large number of exemption clauses, item by item, which would have been necessary to recognize the existing treatment of farm machinery and parts. Even if the United States had been willing to make these concessions, however, it would have been difficult in practice to provide all the exemptions required to accommodate the existing situation. Further, the new tariff structure is much less liberal in its treatment of new devices that may be developed in the future. For example, the grain-loss monitor for combines developed at the University of Saskatchewan appears to be dutiable as an electronic device even though its chief and only use is on farm machinery. Formerly, it could have been imported into the United States duty-free under the "chief use" provision.

In interpreting the U.S. tariff it should be noted that a tariff item covering "parts" of an article covers a product solely or chiefly used as a part of such article, but does not prevail over a specific provision for such part. For example, piston-type engines for tractors are duty-free under tariff item 660.40 but all parts for these engines are subject to duty under item 660.52 at 6.5 per cent unless the part is specifically provided for in yet another section of the tariff. For example, a fuel pump for such an engine would be dutiable under item 660.94 at 8 per cent *ad valorem.*

For some products on which the revision to the U.S. tariff cut off existing trade, it proved possible to obtain later amendments which restored the duty-free treatment. Thus, prior to 1963, tires for tractors, combines and other farm machines had been imported into the United States duty-free as parts for farm machines. Canadian export of these tires amounted to about $2.7 million in 1963. Under the tariff revision these tires became dutiable and exports dropped sharply. Two years later, an amendment restored the duty-free exemption. However, in the meantime, manufacturing facilities had been established in the United States, and Canadian exports have remained well below their former level.

During the Commission's hearings, a number of problem cases relating to the effect of the U.S. tariff on Canadian exporters were brought to its attention:

(1) Two Canadian companies were involved in the manufacture of binder, swather and combine canvases. Cosmos Imperial Mills Limited wove the heavy cotton canvases at its mill in Nova Scotia and Ducan Industries Limited of Lethbridge, Alberta, converted the cotton canvas by rubberizing it, cutting it to size, and adding slats. For a number of years, canvases had been shipped as new and replacement parts for agricultural machines to manufacturers in the United States and to central repair parts depots for manufacturers in Canada. Suddenly a duty of 17.5 per cent had been applied to these parts (as being parts made of rubberized canvas), and both companies saw the business which they had built up disappearing. Even farm machinery manufacturers in Canada would find it difficult to continue purchasing swather canvases from Ducan Limited. They would be able to ship completed machines duty-free to the United States with the binder canvases included, but they would have to pay duty on the replace-

ment canvases. If they bought all canvases in the United States, they would be able to bring them into Canada for original equipment installation and replacement duty-free. The President of Cosmos Imperial Mills reported that he had been told that concessions were being sought from the U.S. Government in other areas to compensate for the effect of the restriction in the new U.S. tariff. He stated that he was not interested in concessions for other industries; that he felt that the two companies had been treated unjustly.

(2) The President of George White & Sons Co. Limited, a specialty short-line manufacturer and distributor, located in London, Ontario, drew the Commission's attention to the problems his company faced in exporting several types of farm machinery to the United States. For example, his company had planned to develop a silage blower (used to fill silos) which would have been duty-free as a farm machine under the old U.S. tariff. However, it was ruled dutiable at 14 per cent as a blower, the all-encompassing descriptive item in the tariff which included all types of blowers, for fans, air conditioners and the like. Similar rulings had been received on two existing product lines, post-hole diggers and snow-blowers. Both items were designed to be attached to farm tractors. Both were exempt from duty coming into Canada, providing an end-use certificate from a farmer was provided. Later advice received by the Commission is that forage blowers are now ruled to be farm machines, and therefore duty-free going into the United States.

(3) A similar complaint was made to the Commission by the Vice-President and General Manager of McCoy-Renn Manufacturing Limited, another specialty short-line manufacturer from Calgary, Alberta. Grain-rollers were produced by this company to spread out and break down the individual grains used to feed cattle so that they would be more easily digestible. These had been ruled as dutiable at 10 per cent as flour-milling machinery, although similar machines from the United States came into Canada free. Small grain-rollers are now ruled to be farm machines, but the largest and most competitive model is still considered dutiable, no matter the actual end-use.

Another product produced by this company was a driven-type combine pick-up. The whole machine was allowed into the United States, but specially designed replacement parts for it were classified under the tariff sections relating particularly to them, and were therefore dutiable. Their combine pick-up was effectively less competitive as a result.

While it appears much has been done to help the individual firms who reported their problems to the Commission, certain conclusions can be drawn:

(1) The informal "free trade" approach taken by the Canadian Government towards farm machinery at the end of the war took the form of unilateral action only. It was intended to benefit Canadian farmers by removing the tariff on farm machines coming into Canada. It did nothing to ensure that the Canadian farm machinery manufacturer was given the same access to the U.S. market as the U.S. manufacturer was being given to the Canadian market.

(2) Between 1944 and 1963, the Canadian-U.S. tariffs roughly "matched", each allowing farm machines generally to enter duty-free on some basis or another. Parts were also covered. Where there were differences, the Canadian door was generally opened wider than the door to the United States. Materials for use in manufacturing farm machines, machine tools used exclusively for farm machines, and all forms of tractors including industrial tractors (except highway truck-tractors) could enter Canada free. All of these items except farm tractors were dutiable going into the United States.

(3) Under the U.S. tariff reclassification of 1963, certain doors previously open to Canadian manufacturers were closed. For some commodities, relief was secured by a Congressional amendment. The attitude of the U.S. Congress, however, became protectionist, and further revisions were not possible.

(4) The offer to negotiate concessions in other areas to compensate for rights lost in the tariff revision is meaningless to the companies that had built their business under existing export barriers and to the communities dependent on them. Legally, however, under GATT, the action of the U.S. Government was entirely correct. Other countries, such as the United States, have general legislation compensation or assistance from public funds to cover companies injured by tariff changes. In Canada, these arrangements have been limited until recently to specific industries, not including farm machinery.

(5) Faced with the existing situation, the only conclusion that can be reached is that the Canadian Government should initiate discussions with the U.S. Government towards the development of reciprocal, unconditional free trade in farm machinery. The arrangement should be broad enough to include new types of machines and parts, so that new items, like the combine loss monitor, would be included. In selling to Canada, other countries, including the United States, virtually have this free trade now, the only significant dutiable item of farm machinery being farm wagons and wagon gear. For the United States, the same holds largely true. Only "nuisance items" of duty remain, undoubtedly almost negligible in their protectionist effect but with unfortunate results for certain small manufacturers in Canada. No major U.S. interest would be prejudiced by permitting free access to *that* market for items like snow-blowers for farm use, grain-rollers, and binder and swather canvases. No significant volume of industrial tractors is currently made in Canada to threaten U.S. plants. It is desirable for Canadian manufacturers to be able to enjoy the economies of scale resulting from access to the total North American market that is open to manufacturers in the United States.

The result would be an equal, fully reciprocal duty-free arrangement between the two countries, giving each country's industry full access to the market of the other. Manufacturers would then be able to plan product development and production facilities on both sides of the border, knowing there would be equal access to both markets by treaty, rather than as the result of two unilateral declarations.

Chapter 16

LOCATIONAL ADVANTAGES IN THE FARM MACHINERY INDUSTRY IN NORTH AMERICA

This chapter examines the changes that have occurred in the location of the farm machinery industry in Canada and the United States over the period since 1900 and assesses some of the reasons for these changes. It then proceeds to a more detailed examination of the comparative cost advantages of three different locations—Brantford, the present centre of the eastern Canadian industry; Moline, Illinois, the centre of the United States industry; and Winnipeg, the centre of the area in Canada that has experienced the most rapid growth in recent years. An examination is also made of the comparative productivity of the industry in Canada and the United States. This analysis provides the basis for some conclusions about the Canadian industry's prospects in the years ahead.

For the most part, past locational changes are measured by using census data on the value of farm machinery shipments or production originating in different regions, states, or provinces. Shipments are not an ideal measure, because they include inter-plant shipments of components as well as finished products. However, shipments or production provide the only data available over the entire period and should be sufficiently accurate to establish the general pattern. Data limitations made it necessary to exclude farm tractors from the analysis prior to 1947. Separate consideration will be given to the location of tractor production later in this chapter.

Early in this century, changes in the location of farm machinery manufacture within Canada saw the growing dominance of Ontario, as Quebec's share declined from 11 per cent in 1900 to 2 per cent or less by 1929, and Ontario's share grew from 87 per cent to over 95 per cent (Table 16.1). A small but significant growth had occurred on the Prairies as early as 1910, but the Prairies' share of the industry's total output increased very slowly over the ensuing 30 years. Since 1945, however, there has been a marked shift towards the Prairies, and its share of total Canadian output increased from 3.5 per cent in 1947 to 13.8 per cent in 1963 and 19.4 per cent by 1967. Since the Second World War, Ontario's share has fallen moderately in percentage terms from just under 95 in 1947 to 83 in 1963 and 76.7

TABLE 16.1 – PERCENTAGE SHARE OF EACH REGION OR PROVINCE IN THE VALUE OF TOTAL SHIPMENTS (OR PRODUCTION) FROM THE FARM MACHINERY INDUSTRY IN CANADA, SELECTED YEARS, 1900-67

(Percentage of value of total shipments)

Region or Province	1900	1910	1920	1929	1939	1947	1954	1963	1967
Atlantic	0.94	0.53	0.08	0.04	0.08	0.04	0.05	0.04	0.70[1]
Quebec	11.26	4.92	4.54	2.07	2.12	1.68	1.41	2.54	3.19
Ontario	87.37	92.85	93.11	95.77	95.37	94.68	91.87	83.45	76.67
Prairies	0.40	1.68	2.06	2.10	2.41	3.53	6.42	13.85	19.40
Manitoba	0.40	1.65	1.72	1.85	2.32	2.25	4.36	9.93	14.92
Saskatchewan	–	0.03	0.07	0.04	–	0.13	0.53	1.52	2.33
Alberta	–	–	0.25	0.20	0.08	1.14	1.54	2.40	2.15
British Columbia	–	–	0.18	–	–	0.04	0.23	0.11	–
Total[2]	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1] Includes British Columbia. Data exclude tractors for all years except 1967.
[2] Totals may not equal 100 because of rounding.

Source: H. Schwartz, *Location of the Farm Machinery Industry in North America,* unpublished Commission study, 1969, and Commission estimates.

in 1967. Manitoba has been the major growth centre on the Prairies, and by 1963 accounted for almost 10 per cent of total Canadian output. Another significant development has been a small growth of output in the Atlantic region, accounted for almost entirely by a manufacturer of potato harvesting equipment. A recent upward trend in Quebec's share is also evident, from 1.4 per cent in 1954 to 3.2 per cent in 1967.

When these changes in the location of Canadian farm machinery output are examined in a North American context, a somewhat different pattern emerges. Thus, as the data in Table 16.2 reveal, Canada's share of total North American output reached a peak of just over 12 per cent in 1910, stayed near that level until 1929, and has since declined to around 8 to 9 per cent of the total. These changes in the Canadian share have been closely paralleled in Ontario's share of the total. The gradual increase in output on the Prairies is also evident in this table, but the rise is greatly reduced in magnitude, and by 1963 production on the Prairies in Canada still accounted for just over 1 per cent of the North American total.

Within the United States over the period from 1900-63 a pronounced westward and southward shift in the location of the industry can be seen. This is particularly evident in the decline in New York's share from 9.1 per cent in 1900 to 3.2 per cent in 1954, and Ohio's share from 12.2 per cent to 4.8 per cent over the same period. It is evident, too, in the share of Illinois which increased moderately from 1900-39 but has since fallen sharply from 45.3 per cent in 1939 to 25.5 per cent by 1954. Although its share of the total is much smaller, the pattern for Indiana has been similar to that for Illinois. In contrast, output in Iowa increased from 1.4 per cent to 9.8 per cent of the North American total between 1900 and 1954, and output in Minnesota from 1.5 to 4.8 per cent. Much of the growth in the West North-Central area has been relatively recent and this region's share of the total increased from 6.8 per cent in 1939 to 26.0 per cent in 1963. Within this last period, 1939-63, significant gains also occurred in the East South-Central region, especially in Tennessee, and to a lesser degree in the South Atlantic and Pacific regions. An exception to the general westward and southward shift of the industry has been the renewed growth of the industry in Pennsylvania. Its share increased from 1.5 per cent in 1939 to 6.0 per cent in 1954. This undoubtedly reflects the growth of New Holland, with its specialization in hay-harvesting and hay-handling equipment.

A comparison of Ontario's share of the North American total with the share of adjacent states in the United States such as Ohio, New York, and even Indiana and Illinois, suggests that up until recently, at least, Ontario has maintained its share of the total as well as or even better than her nearest neighbours in the United States. (However, if the data had included tractors, a somewhat different picture might have been obtained.) For the period before 1944, this can be attributed to Ontario's protected position in the Canadian market and to tariff preferences enjoyed in various parts of the British Commonwealth. Some of Ontario's gain in both the Canadian and North American market between 1900-10 undoubtedly

TABLE 16.2–PERCENTAGE SHARE OF EACH REGION, STATE OR PROVINCE IN THE VALUE OF TOTAL SHIPMENTS (OR PRODUCTION) FROM THE FARM MACHINERY INDUSTRY IN CANADA AND UNITED STATES (EXCLUDING FARM TRACTORS), SELECTED YEARS, 1900-63

(Percentage of value of total shipments)

Region, State or Province	1900	1910	1920	1929	1939	1947	1954	1963
New England	1.28	1.14	0.49	0.33	0.47	0.33	0.03	0.17
Middle Atlantic	12.09	14.30	11.18	7.97	7.02	13.23	9.45	5.15
New York	*9.12*	*10.01*	*8.79*	*6.42*	*5.40*	*7.72*	*3.20*	
Pennsylvania	*2.75*	*3.40*	*1.98*	*1.16*	*1.46*	*4.91*	*5.96*	
East North-Central	69.36	60.82	65.17	65.48	71.36	52.23	48.76	46.09
Illinois	*38.22*	*32.63*	*34.19*	*41.46*	*45.29*	*27.46*	*25.48*	
Indiana	*6.20*	*8.01*	*8.54*	*6.84*	*11.66*	*9.11*	*7.17*	
Michigan	*5.54*	*4.86*	*2.97*	*2.57*	*2.51*	*4.11*	*5.01*	
Ohio	*12.20*	*8.25*	*7.53*	*5.20*	*4.89*	*5.07*	*4.81*	
Wisconsin	*7.18*	*7.05*	*11.91*	*9.38*	*7.00*	*6.45*	*6.28*	
West North-Central	4.24	6.65	4.55	8.67	6.80	16.09	18.61	26.04
Iowa	*1.41*	*3.53*	*2.30*	*2.33*	*2.99*	*7.79*	*9.76*	
Kansas	*0.03*	*0.23*	*0.24*	*0.39*	*0.15*	*1.30*	*1.45*	
Minnesota	*1.53*	*1.64*	*0.77*	*3.70*	*2.53*	*4.52*	*4.84*	
Missouri	*0.83*	*0.55*	*0.44*	*1.48*	*0.45*	*0.82*	*1.53*	
Nebraska	*0.38*	*0.58*	*0.73*	*0.74*	*0.63*	*1.43*	*0.81*	
South Atlantic	1.04	1.25	1.74	1.09	1.82	1.95	2.32	3.46
East South-Central	1.59	1.56	1.80	2.14	2.44	1.80	5.44	6.24
Kentucky	*1.15*	*0.94*	*1.10*	*0.81*	*1.59*	*0.16*	*0.69*	
Tennessee	*0.39*	*0.52*	*0.65*	*1.30*	*0.79*	*0.88*	*3.59*	

West South-Central	0.11	0.23	0.29	0.82	0.27	1.43	1.16	1.76
Mountain	0.07	0.19	0.17	0.08	0.12	0.58	0.57	0.74
Pacific	1.26	1.75	2.82	2.45	1.23	3.83	3.81	2.82
California	1.22	1.61	2.54	2.32	1.06	3.25	3.13	
United States	91.09	87.93	88.24	89.07	91.57	91.51	90.51	92.51
Atlantic	0.08	0.06	0.01	0.00	0.00	0.00	0.00	0.00
Quebec	1.00	0.59	0.53	0.22	0.17	0.14	0.13	0.19
Ontario	7.78	11.20	10.94	10.47	8.04	8.03	8.71	6.24
Prairies	0.03	0.20	0.24	0.23	0.20	0.30	0.60	1.03
British Columbia	–	–	0.02	–	–	0.00	0.02	0.00
Canada	8.91	12.07	11.76	10.93	8.43	8.49	9.49	7.49
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: Data for the United States in earlier years are for 1899, 1909, and 1919. Figures in italics may be selected data only from source in certain cases and therefore will not add to area totals.

Source: H. Schwartz, *Location of the Farm Machinery Industry in North America*, unpublished Commission study, 1969.

reflected her protected access to the rapidly growing Prairie market in Canada. Land under crops on the Prairies increased from 17 per cent of the Canadian total in 1901 to 49 per cent by 1911.

The competitive position of all Canadian producers has been affected by changes in the wage differential between Canada and the United States and by the variations that have occurred in the Canadian exchange rate. Also significant for the Canadian producers have been the changes in the relative importance of the domestic market, exports to the United States, and off-shore exports. In order to provide some perspective on the importance of these considerations, it will be useful to summarize briefly the tariff changes that have occurred in Canada and the United States since 1900 and the changing relative importance of these different markets. Some data will also be provided on wage differentials, adjusted for changes in the exchange rate.

Tariff Changes in Canada and the United States Since 1900

1907 Canadian tariff on harvesting implements reduced from 20 to 17½ per cent; 99 per cent drawback allowed on imported pig iron and rolled iron and steel used in implements manufactured for sale in Canada.

1913 United States tariff removed on all farm implements.

1914 Canadian tariff on harvesting machinery reduced from 17½ to 12½ per cent.

1918 Tractors priced below $1,400 made duty-free (Canada).

1919 Canadian tariff on tillage equipment reduced from 20 to 15 per cent and tariff on plows, higher-priced tractors and portable engines reduced from 20 to 17½ per cent.

1922 Canadian tariff on harvest machinery reduced from 12½ to 10 per cent, on tillage equipment from 15 to 12½ per cent, and on plows from 17½ to 15 per cent.

1924 Canadian tariff on harvest machinery reduced from 10 to 6 per cent, on tillage machinery from 12½ to 7½ per cent, and on plows from 15 to 10 per cent. Pig iron, bar iron and bar steel were placed on the free list when imported for the manufacture of farm implements. Duties on all other materials used in farm implements were set at 7½ per cent.

1930 Canadian tariff on machinery raised to 25 per cent. Duties on farm tractors priced above $1,400 raised from 17½ to 25 per cent. Tractors priced below $1,400 remained duty-free.

1936 Effective January 1, 1936, tariffs on implements reduced from 25 to 12½ per cent on imports from the United States duties on all tractors were eliminated.

1936 As of May, duty on implements imported from the United States reduced from 12½ to 7½ per cent.

1944 Canadian tariff on farm machinery removed completely.

Thus, although the Canadian industry has had tariff-free access to the U.S. market since 1913, it is only since 1944 that the Canadian market has been free from tariffs for the U.S. manufacturer. Except for a brief period from 1930-35 when Canadian manufacturers enjoyed sharply increased protection in a highly depressed market, the trend of Canadian farm machinery tariffs over the period 1900-44 was generally downward, with the sharpest tariff reductions occurring over the period 1922-24. To some degree the tariff reductions occurring between 1907 and 1924 were offset as far as the industry was concerned by provisions for duty drawback or duty-free import of materials.

Some data on the changing importance of different markets for the output of the Canadian farm machinery industry are given in Table 16.3. Over the period since 1900 there has been a persistent if somewhat irregular growth in the significance of the export market, and a corresponding decline in the share of the industry's output sold in the domestic market. Thus, exports as a percentage of farm

TABLE 16.3–DESTINATION OF CANADIAN PRODUCTION OF FARM MACHINERY, SELECTED YEARS, 1900-67

	Exports to United States	Exports to Other Countries	Total Exports	Domestic Sales
	(Percentage of Canadian production)			
1900	–	17	17	83
1910	1	18	19	81
1923	5	18	23	77
1928-30	11	30	41	59
1937-39	14	3	17	83
1946-48	32	20	52	48
1953-55	45	14	59	41
1963-66	67	6	73	27
1967	71	4	75	25

Source: Calculated from Dominion Bureau of Statistics data. Exports in 1900, 1910, and 1923 are for fiscal years closest to calendar years. (See also Table A.7.)

machinery production in Canada rose from 17 per cent in 1900 to 23 per cent in 1923, dropped to 17 per cent in 1937-39, and reached a new peak of 75 per cent in 1967. As the reverse side of this pattern, there has been a decline in the Canadian sales percentage from 83 in 1900 to 25 by 1967. For exports, there has been a gradual increase in the importance of the U.S. market and a decline in the share of Canadian output sold in other export markets. Canadian exports to the United States, which were negligible in 1900 and less than 1 per cent to Canadian output in 1910, amounted to 5 per cent in 1923, 11 per cent in 1928-30, 32 per cent in 1946-48, and 71 per cent in 1967. Exports to the rest of the world were of growing importance to Canadian manufacturers of farm equipment from 1900 until 1928-30, increasing from 17 per cent to 30 per cent of total output over this period. Since 1930 these exports have declined steadily in importance and in 1967 accounted for only 4 per cent of Canadian output.

Both the reduction in tariff protection and the declining importance of Canadian off-shore exports help to explain the decline in Ontario's share of North America's output. The increasing importance of Canadian exports to the United States has also tended to favour the Prairies as a location for farm machinery output relative to Ontario.

The above census data, for farm machinery excluding tractors, show a significant decline in the Canadian share of North America's total production from a peak of around 12 per cent in 1910 and 1920 to about 7.5 per cent by 1963. For the postwar period, a year-by-year comparison of the Canadian share of total production including tractors is possible, using the data given in the Commission study on productivity prepared by Christopher J. Maule.[1] This comparison, which is presented in Table 16.4, shows that although there has been a modest decline in the Canadian share compared with the early postwar period when Canada still had a significant off-shore export market, this share has remained fairly constant since 1955. Moreover, the results obtained are not greatly different whether the Canadian share is measured by the value of shipments or by value added. The decline as compared with the early postwar years has been slightly larger where the share is measured by value added than when value of shipments is used.

TABLE 16.4–CANADA'S AVERAGE ANNUAL SHARE OF NORTH AMERICAN FARM MACHINERY PRODUCTION, 1947-66

(Canada as percentage of North American total)

	Value of Shipments	Value Added by Manufacture
1947-49	7.9	8.8
1950-54	8.1	8.9
1955-59	6.8	7.6
1960-63	6.6	7.4
1964-66	7.4	7.5

Source: C. J. Maule, *Productivity in the Farm Machinery Industry: A Comparative Analysis between Canada and the United States,* Study No. 3, Royal Commission on Farm Machinery (Ottawa: Queen's Printer, 1969), Tables A5 and A6.

When the above data are compared with the longer historical series presented in Table 16.2, it becomes apparent that both series show about the same share of production for Canada. The earlier series shows a share of 8.5 per cent in 1947, 9.5 per cent in 1954, and 7.5 per cent in 1963–not greatly dissimilar from the data for this period in Table 16.4. Yet the latter table includes tractors as well as other farm machinery, whereas the former table excludes tractors. Since Canada has very little tractor production, one would expect the data in Table 16.4 to show a much smaller share of the market going to Canadian producers. This apparent anomaly is explained by the fact that the data given in Table 16.4 incorporate the effects of the upward valuation of Canadian shipments and value-added data needed to place

[1] C. J. Maule, *Productivity in the Farm Machinery Industry: A Comparative Analysis between Canada and the United States,* Study No. 3, Royal Commission on Farm Machinery (Ottawa: Queen's Printer, 1969).

both United States and Canada on a comparable basis. The earlier series presented in Table 16.2 probably gives a valid indication of the long-term trend. However, the series in Table 16.4 provides a much better measure of the recent trend in the Canadian share of North American farm machinery production. Not only does it include tractors and a correction for the undervaluation of published Canadian data, but because it is based on annual averages it is less vulnerable to the effects of unusual year-to-year variations. In brief, these data show that the Canadian industry currently makes about 7.5 per cent of the farm machinery produced in Canada and the United States. This represents a modest decline from the 8 to 9 per cent share for the period 1947-54.

A general picture of the farm machinery market in North America is provided by Figures 16.1, 16.2, and 16.3,[2] which show the distribution of tractors, combines, and balers, on farms in Canada for 1966 and the United States for 1964. These maps indicate quite clearly that locations such as Moline, Illinois, Des Moines, Iowa, and Milwaukee, Wisconsin—the regions in which many North American plants are located—are very close to the centre of the North American market.

Locational Advantages of Brantford, Moline, and Winnipeg

One approach to assessing the competitive advantage of different locations for the manufacture of farm machinery is to carry out the detailed kind of plant-location study that is normally prepared when a farm machinery firm is considering establishing a new plant. In such a study all the various costs that affect the relative advantages of different locations are studied in detail. Such a study was prepared by the Commission's staff for Brantford, Moline, and Winnipeg.[3] In assessing the comparative advantages of these three locations, it was assumed that the farm machinery would be sold entirely in Canada or the United States. Since Canadian exports to other countries now account for only 3 per cent of her annual output, and U.S. exports outside North America amount to only about 6 per cent of U.S. output, it seems reasonable to neglect the effect that potential sales to third markets would have on the location decision. Comparison of these three locations is further facilitated by the fact that they now all produce self-propelled combines, one of the industry's major products.

In making this comparison it was assumed that all three points were producing the same products in the same volume, were using the same technology, and employed the same amount of materials, labour, and capital equipment. Thus the plants were assumed to be virtually identical. To some degree, the technology and

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[2] Prepared for the Royal Commission on Farm Machinery by Professor D. M. Anderson and Professor D. R. F. Taylor of the Geography Department of Carleton University, Ottawa. Data taken from analysis of *1966 Census of Canada, Agriculture,* and United States *1964 Census of Agriculture.*

[3] N. B. MacDonald, *Locational Advantages in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970).

Figure 16.1 — Distribution of Tractors — 1964-66

Figure 16.2 — Distribution of Combines — 1964-66

Figure 16.3 – Distribution of Balers – 1964-66

production processes in different locations are, in fact, adapted to the relative prices of labour, capital, and materials. However, for the price differences that exist between these three locations, it was believed that there would be no significant modifications in production processes or technology. It was also assumed that costs and profits related to wholesaling and retailing, other than outbound transportation, would have no effect on plant location.

Cost data collected by the Commission indicate that the manufacturer's factory costs, including profit, amount to about 61 per cent of the suggested retail list price of farm machinery or about 84 per cent of the net price to the dealer. The costs affecting the location decision are within the 61 per cent. In the following analysis, these total factory costs will be considered in two groups, (1) manufacturing costs (roughly 54 per cent of retail list) and (2) other costs associated with the manufacturing location including outbound transportation costs and costs of income taxes. These latter costs will be labelled post-production costs.

Manufacturing Costs

With the quantities of materials, labour, and capital used at different locations assumed to be fixed, variations in manufacturing costs will mainly reflect differences in material prices or in salary and wage rates, differences in overhead costs such as property tax rates, and variations in inbound transportation costs. As a basis for judging the importance of different costs, the manufacturing cost data for four major Canadian farm machinery manufacturers were used. These data are presented in Table 16.5. The four firms in question–Massey-Ferguson, International Harvester, Cockshutt, and John Deere–manufacture in their Southwestern Ontario plants a variety of farm machines including combines, hay-balers, tillage equipment, drills, swathers, manure spreaders, and rotary mowers. Thus the cost data reflect the cost pattern of a broad range of farm machines (with the exception of tractors) for a plant located in Southwestern Ontario, referred to in the study as "Brantford". These data give the following breakdown of manufacturing costs: materials 53 per cent, direct labour 16 per cent, and overheads 31 per cent. The importance of each of these groups for the location decision is now considered in detail.

Costs of Acquiring Materials and Components – The Canadian farm machinery industry can import both materials and components on a duty-free basis. Thus, Canadian plants are free to take advantage of the cheapest source for any material or component. Indeed, in respect to materials, Canadian plants may sometimes have an advantage over plants in the United States. For example, in 1969, steel was lower in price in Canada than in the United States by amounts ranging from 5 to 12 per cent. Thus Canadian farm machinery plants would buy Canadian steel. However, U.S. farm machinery plants do not have similar duty-free access to Canadian materials and components. If a material or component is not specifically mentioned in the U.S. tariff, it can be imported duty-free as a part for a farm implement. But wherever the material or component is specifically covered in the tariff, the U.S. firm would have to pay duty on its import. No

TABLE 16.5 BREAKDOWN OF MANUFACTURING COSTS IN ONTARIO, FARM MACHINERY INDUSTRY, 1966 (AVERAGE OF FOUR COMPANIES)

	Percentage of Total Manufacturing Costs
Materials	
Purchased items	52.02
Inbound transportation	0.98
Total materials	53.00
Direct Labour	
Wage costs	12.11
Fringe benefits	3.92
Total direct labour	16.03
Overheads	
Indirect labour (including fringes)	7.52
Salaries (including fringes)	6.88
Maintenance	3.11
Depreciation	2.28
Warehousing and freight	1.82
Production tooling	1.49
Obsolescence, warranty	1.49
Administration	1.36
Power, light, heat, etc.	1.09
Operating supplies	1.08
Property taxes	0.84
Expense, tools	0.70
Defective work and scrap	0.63
Insurance	0.06
Other	0.62
Total overheads	30.97
Total manufacturing costs	100.00

Source: N. B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 3.1, p. 16.

specific allowance for this advantage of Canadian plants is included in this analysis. Since purchased components make up over half of the total manufacturing cost of farm machinery, it could be a rather important factor. If it were assumed that steel accounted for 40 per cent of purchased components and that Canadian plants had a 7.5 per cent price advantage on steel, the result would be an advantage on total manufacturing costs of 3 per cent. However, this potential advantage was not further considered in the study.

Apart from these differences that plants in North America have in their purchase of materials and components, the major difference in these costs that one location may enjoy over another is in respect to inbound transportation costs. These inbound transport costs may vary from one location to another for a number of reasons--the type of transport that is available (highway, rail, or ship), the minimum shipping weights required, and the rate structures themselves. Moreover, transport costs may be affected by basing-point practices (a form of freight-cost

equalization), free delivery (the vendor pays the freight or uses his own trucks) and inventory control and associated costs (as the distance from the vendor increases, the "safety float" of materials inventory en route or in the plant must be increased). The variety and complexity of these factors make it difficult to be as precise in measuring inbound transport costs as is possible with other cost items.

In its submission to the Commission, Massey-Ferguson presented an analysis of the difference in the costs of locating a tractor-assembly plant and its supporting transmission and axle plant in Brantford rather than Detroit. The company also presented an analysis of the costs involved in locating their Brantford combine-assembly plant in Winnipeg instead of Brantford. In both instances, a substantial part of the cost difference between these locations reflected the additional cost of inbound transportation on materials and components. These and other data provided by the company were analyzed in some detail, and are the basis for the comparison of inbound freight costs presented in Table 16.6. The results of this analysis show that the cost of bringing in materials and components, expressed as a percentage of Brantford's total manufacturing cost as a base, would amount to about 0.98 per cent in Brantford, 2.16 per cent in Winnipeg, and 0.44 per cent in Moline (taken as equal to Detroit). These cost comparisons are made on the assumption that a Winnipeg plant would continue to buy its raw materials and components from the same sources as the present Brantford combine plant, and that a Brantford tractor plant would buy most of its materials and components from the same suppliers as the Detroit plant. To some degree this will overstate the disadvantages of the Brantford and Winnipeg locations. On some materials or components there would be an opportunity to substitute local or closer suppliers and thus reduce costs.

Associated with the purchase of materials and components are certain indirect cost penalties that cannot be easily measured. Where components or materials have to be obtained from a distant source, the manufacturer can expect to spend more in the form of office overhead to secure the same control over his product as a manufacturer who can buy locally. When the material or parts cross the border, a further cost is added. Each shipment of parts received by a Canadian farm machinery manufacturer must have a customs entry form completed, even though the parts themselves are duty-free. It has been estimated that the cost of completing each such form is at least five dollars. However, because these additional costs are relatively small, no specific allowance is made for them in the present cost comparison.

Costs of Hourly Paid and Salaried Personnel – Table 16.7 gives data on wage and salary rates and fringe benefits for direct labour, indirect labour, and salaried employees, for each of the three locations. The relative importance of each of these components of manufacturing costs in 1966 is shown in this table. The data are given both in terms of Canadian dollars and on a relative index-number basis with Brantford taken as equal to 100, and are for rates in effect during 1966.

TABLE 16.6–COMPARISON OF INBOUND FREIGHT COSTS AT BRANTFORD, ONTARIO, WINNIPEG, MANITOBA, AND MOLINE, ILLINOIS, AS PERCENTAGE OF BRANTFORD MATERIAL COSTS

	Brantford	Winnipeg	Moline	Relative to Material Percentage, Table 16.5
	(Thousands of dollars)			(Per cent)
Brantford, Ontario				
Inbound freight costs reported in Massey-Ferguson brief (p. 37, Ch. VII) for all Canadian M-F plants–taken as typical of Brantford location:				
Material costs	$70,334			52.02
Freight costs	1,323			0.98
Total	$71,657			53.00
Winnipeg, Manitoba				
Inbound freight costs reported in Massey-Ferguson brief (p. 24, Ch. IV) for Winnipeg as opposed to Brantford location:				
Material costs		$70,334		52.02
Freight costs at Brantford		1,323		
Additional freight costs for Winnipeg location of combine plant		1,600		
Freight costs		2,923		2.16
Total		$73,257		54.18
Detroit, Michigan (used for Moline, Illinois)				
Inbound freight costs–Brantford as 2.21 times Detroit freight:				
Material costs			$70,334	52.02
Freight costs ($1,323 ÷ 2.21)			599	0.44
Total			$70,933	52.46

Source: From N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer 1970), Table 3.3, p. 24.

These data show a very considerable advantage for Winnipeg over both Brantford and Moline in respect to labour costs. Winnipeg's advantage is particularly marked in respect to fringe benefits. Winnipeg's wage and salary rates are from 19 to 31 per cent below those in Southern Ontario (taken as Brantford) and her total fringe benefits would be less than one-fourth of the Brantford level.

Overall, using the weights given in Table 16.7, Winnipeg has an advantage of 39 per cent on salary and wage costs. In contrast, wage rates, salaries, and fringe benefits are higher in Moline than in Brantford. The differential is much larger for salaries and indirect labour than it is for direct labour. A weighted average of all these rates shows that Moline's labour costs in 1966 were about 21 per cent higher than those

TABLE 16.7–COMPARISON OF AVERAGE WAGE AND SALARY RATES, THE FARM MACHINERY INDUSTRY, CANADA AND UNITED STATES, 1966

(Canadian dollars)

	Canada		United States
	Brantford Ontario	Winnipeg Manitoba	Moline Illinois
Direct Labour Wage Rates			
Average hourly wage rate	2.81	1.93	3.21
Hourly fringe benefit cost	0.91	0.20	0.98
Total direct labour cost	3.72	2.13	4.19
Compared to Brantford as 100			
Average hourly wage rate	100	69	114
Hourly fringe benefit cost	100	22	108
Total direct labour cost	100	57	113
Indirect Labour Wage Rates			
Average hourly wage rate	2.70	2.01	3.50
Hourly fringe benefit cost	0.87	0.21	1.07
Total indirect labour cost	3.57	2.22	4.57
Compared to Brantford as 100			
Average hourly wage rate	100	74	130
Hourly fringe benefit cost	100	24	123
Total indirect labour cost	100	62	128
Salary Rates			
Average weekly salary rate	81.06	65.54	111.97
Average salary fringe benefits	26.26	6.75	34.15
Total salaried employment costs	107.32	72.29	146.12
Compared to Brantford as 100			
Average weekly salary rate	100	81	138
Average salary fringe benefits	100	26	130
Total salaried employment costs	100	67	136

Source. Wage and salary rates from returns of *Survey of Wages*, Department of Labour for Canada, and from *Wage Survey*, U.S. Department of Labor, Bureau of Labor Statistics. Fringe benefit data were collected from five Canadian and eight U.S. companies by the Commission. N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 3.4, p. 26.

in Brantford and almost double those in Winnipeg. Taking total manufacturing costs in Brantford as 100, total labour cost in Brantford would be 30.43, in Winnipeg 18.49, and in Moline 37.03. Wage increases between 1966 and 1968 changed these relationships by only moderate amounts. In terms of 1968 salary and wage rates, total labour cost for Moline was about 18 per cent higher than in Brantford and about 92 per cent higher than those in Winnipeg. Again using total manufacturing costs in Brantford as 100, total labour cost would be 33.28 in Brantford, 20.38 in Winnipeg, and 39.16 in Moline. Data on 1968 salary and wage rates are given in Table 16.8.

TABLE 16.8 –COMPARISON OF AVERAGE WAGE AND SALARY RATES, THE FARM MACHINERY INDUSTRY, CANADA AND UNITED STATES, 1968

(Canadian dollars)

	Canada		United States
	Brantford Ontario	Winnipeg Manitoba	Moline Illinois
Direct Labour Wage Rates			
Average hourly wage rate	3.19	2.21	3.44
Hourly fringe benefit cost	1.03	0.23	1.05
Total direct labour cost	4.22	2.44	4.49
Compared to Brantford as 100			
Average hourly wage rate	100	69	108
Hourly fringe benefit cost	100	22	102
Total direct labour cost	100	58	106
Indirect Labour Wage Rates			
Average hourly wage rate	3.11	2.36	3.78
Hourly fringe benefit cost	1.01	0.24	1.15
Total indirect labour cost	4.12	2.60	4.93
Compared to Brantford as 100			
Average hourly wage rate	100	76	122
Hourly fringe benefit cost	100	24	114
Total indirect labour cost	100	63	120
Salary Rates			
Average weekly salary rate	92.30	75.30	131.60
Average salary fringe benefits	29.90	7.80	40.10
Total salaried employment costs	122.20	83.10	171.70
Compared to Brantford as 100			
Average weekly salary rate	100	82	143
Average salary fringe benefits	100	26	134
Total salaried employment costs	100	68	141

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 3.5, p. 27.

The data on labour cost shown in the above comparison are based on wages and salaries actually paid in farm machinery plants in the three different areas. The disparity between Winnipeg and Brantford in these data is substantially larger than is true for an average of all industries in the two areas. This is due to the fact that as compared with Winnipeg, farm machinery in Southern Ontario is produced by much larger firms, and firms in which a larger proportion of the workers is in strong union organizations. If firms in the Winnipeg area continue to grow in size, or if some of the major companies establish plants in the region, some of the wage advantages that now accrue to the area may disappear. In these circumstances, unions in other locations could be expected to resist the erosion to their position by lower labour cost in Winnipeg.

Labour Productivity – Salary and wage rates and the level of fringe benefits are only a valid measure of relative labour cost per unit of output if the level of labour productivity is the same in each location. Further, even if labour productivity is higher in one location than another, and as a result unit labour costs are lower, the effect of this on total unit costs may be wholly or partially offset if these productivity gains are achieved by the use of more capital equipment. While labour productivity is difficult to measure with any precision, it will be useful to review what evidence is available on this question.

An earlier study published by the Royal Commission on Canada's Economic Prospects estimated that productivity measured by value added per worker in the farm machinery industry in Canada was only about 68 per cent of that in the United States. The comparative study on productivity undertaken for the Commission[4] discovered that there were serious deficiencies in the data on which this earlier estimate had been based. This error arose out of the fact that the value of shipments was being reported on a different basis in Canada than it was in the United States. In fact, a significant part of the Canadian industry's output was reported at standard factory cost, a basis which does not include an allowance for profit at the manufacturing level. In contrast, in the United States many shipments were reported at a valuation equal to about two-thirds of the suggested retail price. This basis of valuation was used particularly by the full-line firms which sold farm machinery through their own branch-house organization. For these firms, the price of machinery at the factory is just a transfer price, a price at which goods are transferred from one branch of the organization to another.

When the Canadian data were adjusted to a valuation basis more closely approximating that used in the United States, the result was a significant increase in the value added per worker in Canada. For the period studied, 1947-66, the results show that the productivity of employees in the Canadian industry is of the order of 80 to 83 per cent of that achieved in the American industry. Three alternative measures produced the results shown in Table 16.9.

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[4]Maule, *op. cit.*

TABLE 16.9–PRODUCTIVITY IN THE FARM MACHINERY INDUSTRY, CANADA AS PERCENTAGE OF THE UNITED STATES

	Per Production Worker	Value Added in Current Dollars per Employee	Per Man-Hour Paid, Production Workers
1947-51	82.4	80.8	82.6
1952-59	83.1	84.1	82.1
1960-66	78.0	78.0	79.7
1952-66	80.5	81.2	80.9

Source: C.J. Maule, *Productivity in the Farm Machinery Industry: A Comparative Analysis between Canada and the United States*, Royal Commission on Farm Machinery, Study No. 3 (Ottawa: Queen's Printer, 1969), Table 7.

It has not been possible to establish precisely what factors account for the remaining 17 to 20 per cent difference in productivity between Canada and the United States. In testimony before the Commission, Massey-Ferguson expressed the view that Canadian workers were just as productive as American workers. However, it also reported that its U.S. manufacturing operations were more capital-intensive than was true for Canada. For its manufacturing and engineering divisions in a number of different countries, Massey-Ferguson reported the following investment in assets per employee: Canada \$8,100, United States \$22,300, Europe \$7,000, Australasia \$4,400, Latin America \$10,950, and Africa \$5,100. Thus some of the higher productivity reported for the United States may reflect the fact that manufacturing operations there are more capital-intensive, and as a result each worker is working with a larger amount of capital equipment.

Although the Maule study showed productivity levels for Canada from 80 to 83 per cent of U.S. levels, it was decided somewhat arbitrarily to base the analysis in this section on the assumption that labour productivity levels for Brantford and Winnipeg would be, respectively, 93 and 90 per cent of those for Moline. The present analysis assumes production of identical products in identical plants. In these circumstances, it seems unlikely that a productivity difference as large as 17 or 20 per cent would occur. Nevertheless, in a concluding section some attention is given to the effects of alternative productivity assumptions. Both higher and lower productivity levels will be considered.

Massey-Ferguson also reported that following the removal of its Woodstock operation to Des Moines, Iowa, it obtained "increased efficiencies including substantially improved work standards of approximately 40 per cent in assembly and 50 per cent in welding with an over-all increase of output per man-hour judged to be between 10 and 15 per cent". They also stated that "Such an improvement might have arisen entirely from improved facilities and manufacturing methods, a new employee work group and improved work standards, regardless of location". Thus some of the remaining productivity difference between Canada and the United States may reflect some of these factors. It may be noted that as the largest

Canadian manufacturer, Massey-Ferguson, still has a substantial part of its production concentrated at a very old factory site in Toronto.

Productivity as measured by value added reflects the price at which the product sells. If the products of all firms have about the same value in the eyes of the customer and are equally well located to serve the market this should give a good measure of productivity. But to the degree that some firms have built up over the years a reputation for their brand name that allows them to charge a higher price, the productivity of these firms measured by value added will contain an element which does not reflect productivity in any physical sense. Similarly, where firms located away from the centre of the market have to accept a lower net price at the factory, their value added per worker will be lower. Both of these considerations may have some influence on the comparison of productivity between Canada and the United States. The largest Canadian manufacturer, Massey-Ferguson, is currently attempting to increase its market penetration in the United States and may well be accepting lower prices for equivalent products in order to achieve this goal. Certainly, Commission studies suggest that both Cockshutt and Massey-Ferguson combines, for equivalent sizes and models, sell at prices significantly below the prices of comparable combines sold by Deere and International Harvester, the two dominant firms in the U.S. market. Combines for the former two companies are manufactured in Canada, while those for the latter two are manufactured in the United States. And the major part of Canadian production must accept some transport-cost penalty.

Finally, it should be noted that productivity depends to a significant degree on the scale of production at which a plant operates. Thus the data provided by the Commission's study on *Farm Tractor Production Costs* show that productivity of both labour and capital increase very substantially when production increases from 20,000 to 90,000 tractors per year. For a variable make-buy mix of tractors, value added increases by 57 per cent per employee, by 45 per cent per production worker, and by 85 per cent per $1,000 of invested capital, over the range from 20,000 units to 90,000. The data are as follows:

	Annual Output of Factory		
	20,000	60,000	90,000
Value added per employee	$14,714	$19,762	$23,093
Value added per production worker	20,887	26,945	30,187
Value added per $1,000 of capital	423	652	782

To the degree that farm machinery plants in the United States operate at higher-volume levels their productivity in terms of value added would be higher. Since Canadian plants in many cases produce for the entire North American market, it is not obvious that American plants do achieve larger economies of scale. However, tractor production in North America is almost entirely in the United States and tractors are one of the larger-volume farm machines. Rough estimates made by the Commission indicate that economies of scale available in tractors may

account for around 3 percentage points of the difference in productivity in this industry between Canada and the United States. Economies of scale in other products may account for some of the remaining difference.

Labour Supply – An important consideration in deciding where to locate a farm machinery manufacturing facility is the availability of labour of the desired skills and quality. New Holland reported that before deciding to locate a new combine manufacturing plant at Grand Island, Nebraska, they had given serious consideration to Winnipeg as an alternative site. In deciding against Winnipeg they reported that an important factor had been the lack of tool and die makers in the Winnipeg area. They had estimated their requirements for this class of worker as 20 initially and 33 in the first five years and they had found that there were only 52 in all of Manitoba. They also reported that with the new technical school training facilities which had recently been made available, they would have been able to arrange to have the needed supply of workers trained. Both Moline and Brantford are in major manufacturing areas and could be expected to have workers available with the required skills. It would appear that the quality of Winnipeg's labour supply is improving and in the future may well be adequate to meet most normal requirements of any new farm machinery manufacturer. All three areas under consideration would appear to have the school, community, and recreational facilities needed to attract the important salaried supervisory and executive class of worker. New Holland also noted that Canadian workers were less willing than U.S. workers to move from one job to another. This would make the initial staffing of a new factory difficult, but would be an advantage once the plant was operating.

Overhead Costs – Salaries and the wages of indirect labour are an important component of overhead costs, but these were considered above along with the wages of direct labour. Operating supplies used directly in the production process such as drill bits, thinners and solvents for paints, sand paper, welding rods and gases, make up about 1 per cent of manufacturing costs. These items can be imported on a duty-free basis by a Canadian manufacturer of farm machinery, and are free of federal sales tax. Since 1969, the Ontario sales tax of 5 per cent has applied to operating supplies. In Illinois these supplies would be free of both state and federal sales tax, although in adjacent Iowa they would be subject to a 3 per cent state tax.

Production tooling and expense tools, which together amount to about 2.2 per cent of total manufacturing costs, are tax-free at both the provincial and federal level. In the United States they would pay a 5 per cent state tax in both Iowa and Illinois.

Power, light and heat, accounting for just over 1 per cent of manufacturing cost, can be broken down on the basis of Canadian census data into electricity (42.5 per cent), natural gas (25.9 per cent), fuel oil (16.3 per cent), and coal (15.3 per cent). The relative cost of each of these components and a weighted average of all four for each of the three locations are given in Table 16.10.

TABLE 16.10–POWER, LIGHT AND HEAT COST, THREE FARM MACHINERY LOCATIONS (BRANTFORD = 100)

	Relative Percentage Weights	Brantford	Winnipeg	Moline
Gas	25.9	100.0	91.23	108.77
Electricity	42.5	100.0	59.31	208.57
Fuel oil	16.3	100.0	89.24	111.96
Coal	15.3	100.0	161.46	92.78
Weighted average		100.0	88.08	149.25
With cost weight of "power, light, heat, etc." in Table 16.5 taken as Brantford level		1.09	.96	1.63

Sources: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Ch. 3, p. 35.

For a number of other components of overhead costs it seems likely that costs would be about the same in all three locations. This would be true of defective work and scrap, obsolescence, and warranty and insurance. For lack of definite data it was also assumed that property taxes, which are less than 1 per cent of manufacturing costs, would be identical in all three locations.

Data on maintenance, taken from *Farm Tractor Production Costs* indicate that this cost item is made up of about two-thirds labour and one-third materials. Maintenance costs were then estimated on the assumption that materials costs would be identical in all three locations and labour costs would vary by the ratios shown above for indirect labour.

Another important component of cost is depreciation on plant and equipment. Available data suggest that about 70 per cent of this total is for depreciation on machinery. Except for a short period, Canadian manufacturers have been able to buy their equipment on a tax-free basis, and the farm machinery industry can import machinery free of duty. On the other hand, evidence given to the Commission by the Ford Motor Company suggests that the cost of a new building in Canada would be some 7 per cent higher than a comparable building in the United States, largely because of the 11 per cent sales tax on building materials. Another source suggested that building costs in Southern Ontario were about 9 per cent lower than in Moline, with Winnipeg a further 2 per cent lower. After assessing these data, factors of 100, 97 and 94 were chosen for Brantford, Winnipeg, and Moline, respectively, to represent relative building-cost levels.

Two other cost areas are warehousing and freight, and administration. With Brantford taken as 100, both of these costs were assumed to be about 90 in Winnipeg on the basis of their nearness to the Prairie market and the lower wage and salary level in the region. For Moline, which is also closer to the centre of the farm machinery market, but must pay higher labour rates, factors of 95 and 99 were selected.

The accumulated effects of these various cost differences for each of the three locations are presented in Table 16.11. This analysis shows that the manufacturing cost of farm machinery in Winnipeg would be about 12 per cent below its level in Brantford. In contrast, manufacturing costs in Moline would be about 6 per cent higher than in Brantford. The table also shows the relative level of each component of total manufacturing cost for Winnipeg and Moline with Brantford taken as 100.

TABLE 16.11 COMPARATIVE MANUFACTURING COST ADVANTAGE OF FARM MACHINERY MANUFACTURING PLANTS IN BRANTFORD, WINNIPEG, AND MOLINE, 1966 WAGE AND SALARY RATES

Cost Factor	Brantford	Adjusting Factor	Winnipeg	Adjusting Factor	Moline
	(Base)	Brantford/ Winnipeg	Relative Cost	Brantford/ Moline	Relative Cost
Materials					
Purchased items	52.02		52.02		52.02
Inbound transportation	.98		2.16		.44
Materials	53.00		54.18		52.46
Direct Labour					
Wage costs	12.11	69	8.36	114	13.81
Fringe benefits	3.92	22	.86	108	4.23
Direct labour	16.03		9.22		18.04
÷ Productivity factor	1.00		.96		1.08
Adjusted direct labour	16.03		9.60		16.70
Overheads					
Indirect labour (incl. fringes)	7.52	62	4.66	128	9.63
Salaries (incl. fringes)	6.88	67	4.61	136	9.36
Maintenance	3.11	100	2.33	100	3.69
Depreciation	2.28	98	2.26	95	2.25
Warehousing and freight	1.82	90	1.64	95	1.73
Production tooling	1.49	100	1.49	100	1.49
Obsolescence and warranty	1.49	100	1.49	100	1.49
Administration	1.36	90	1.22	99	1.35
Power, light, heat, etc.	1.09	88	.96	149	1.63
Operating supplies	1.08	100	1.08	100	1.08
Property taxes	.84	100	.84	100	.84
Expense tools	.70	100	.70	100	.70
Defective work and scrap	.63	100	.63	100	.63
Insurance	.06	100	.06	100	.06
Other	.62	100	.62	100	.62
Total overheads	30.97		24.59		36.55
Total manufacturing costs	100.00		88.37		105.71

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Tables 3.3 and 3.7.

Post-Production Differentials

Products of the farm machinery industry are usually sold or transferred to distributors or the firm's distribution division at about 61 per cent of the suggested retail list price. This provides a margin of some 7 per cent to cover the return on capital invested at the manufacturing level and other corporate expenses such as research and development. Of this total, about 3 per cent (of retail list) represents net manufacturing profit and interest on invested capital. In addition, outbound transportation costs are required before the machinery reaches its destination. The location decision may be affected by each of these costs.

Outbound Transportation Costs – The cost of shipping machinery to the dealer is normally added to the price to the dealer, and thus becomes part of the final price to the farmer. Thus the amount of these charges will vary from one location to another. Since, for the most part, farm machinery is sold f.o.b. factory, each manufacturer will have to consider his locational advantages or disadvantages relative to his competitors in setting his prices. This is particularly true where major competitors are some distance apart.

Some data on outbound transportation costs for farm machinery were prepared for the Commission and appear in Table 16.12. These data show the relative costs of shipping four major types of machines from each of the three locations under study. The estimates assume that the products would be sold throughout the North American market in proportion to the total sales in each region. These data show that Moline has a very significant advantage over both Winnipeg and Brantford in respect to outbound transport costs. Relative to Brantford, Moline's advantage varies from 38 per cent on self-propelled combines to 28 per cent on disk harrows. Winnipeg would have higher transport costs than Brantford for tractors and disk harrows but lower costs for combines and balers. For a plant producing combines, these transport costs would amount to 1.08 per cent of suggested retail price at Moline, 1.52 per cent at Winnipeg, and 1.75 per cent at Brantford.

TABLE 16.12–COMPARATIVE OUTBOUND FREIGHT COSTS FOR SPECIFIED PRODUCTS, BRANTFORD, WINNIPEG, AND MOLINE

	Weighted Average Shipping Costs to Supply North American Market from:					
	Brantford		Winnipeg		Moline	
Farm Machine Type	$ Can.	Relative	$ Can.	Relative	$ Can.	Relative
Wheeled tractor	100	100	116	116	69	69
Self-propelled combine	179	100	156	87	110	62
Automatic baler	44	100	41	93	29	66
Tandem wheel-type disk harrow	36	100	40	111	26	72

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 4.1, taken from Appendix D, prepared for Royal Commission on Farm Machinery by Kates, Peat, Marwick & Co.

On the other hand, if it is assumed that a plant in Winnipeg limits itself to products that sell in the plains area of Canada and the United States, Winnipeg's disadvantage relative to Moline disappears. Table 16.13 gives a comparison of the cost of shipping a combine to various points on the Prairies. For this market Winnipeg's outbound transport costs would be some 42 per cent lower than those of a plant in Brantford, and Moline's 39 per cent lower.

TABLE 16.13–COMPARATIVE OUTBOUND FREIGHT COSTS FOR SELF-PROPELLED COMBINES TO WESTERN CANADIAN AND U.S. MARKETS, BRANTFORD, WINNIPEG, AND MOLINE

Canadian Provinces or U.S. Geographical Area and (Analyzed) Destination Points (in Parentheses)	Share of North American Market in Province or Area	Relative Cost if Shipped from: Brantford		Winnipeg		Moline	
		Rail Rate	Rate x Market Share	Rail Rate	Rate x Market Share	Rail Rate	Rate x Market Share
		$		$		$	
Manitoba (Winnipeg)	2.8	2.49	6.97	.53[1]	1.48	1.58	4.42
Saskatchewan (Regina)	8.0	3.14	25.12	.57	4.56	2.17	17.36
Alberta (Edmonton)	5.0	3.90	19.50	1.14	5.70	3.07	15.35
U.S. Plains States (Omaha, Nebraska)	28.2	1.69	47.66	1.62	45.68	0.84	23.69
	44.0		99.25		57.42		60.82
Relative to Brantford as 100			100		58		61

[1] Highway transport to Brandon assumed for Manitoba.

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 4.3, p. 51.

While outbound transport costs are large enough to have a significant effect on a company's location decision, for major products they apparently do not alter seriously the relative prices of different companies' products. This is shown by the data in Table 16.14 which compares the f.o.b. factory and delivered prices of comparable combines for three different market areas when shipped from each of the three locations under study. For ease of comparison delivered prices of each combine at each point are expressed as a ratio to John Deere's delivered price taken as 100. It is clear that the difference added to the price by transport charges is small relative to the price difference that already exists on what are more or less comparable models of combines.

Corporate Income Tax and Other Capital Costs – Locational decisions may also be affected by the level of corporate income tax rates in different countries or areas. Analysis of federal and state or provincial taxes in Canada and the United States suggest that a firm of moderate size–one with total profits well over $1 million–would currently pay tax rates of 52.1 per cent in Moline, 51.4 per cent in Brantford, and 50.9 per cent in Winnipeg. These rates do not take account of any

special tax concessions that might be obtained under area-development schemes, research programs or other special arrangements, and do not include the investment credit until recently in effect in the United States.

TABLE 16.14–EFFECTS OF TRANSPORT COSTS ON DELIVERED PRICE OF COMBINES FROM BRANTFORD, WINNIPEG, AND MOLINE TO SELECTED DELIVERY POINTS, 1968

Location of Factory	Suggested Retail Price f.o.b. Factory		Suggested Retail Price at Delivery Points: Des Moines, Iowa		Brandon		Edmonton	
Brantford								
Cockshutt 542	$ 9,953		$10,200		$10,269		$10,402	
Delivery charges			247		316		449	
Relative number[1]		80.5		82.0		81.2		81.4
Massey-Ferguson 410	11,407		11,617		11,744		11,886	
Delivery charges			210		337		479	
Relative number[1]		92.3		93.4		92.9		93.1
Winnipeg								
Versatile 420	8,900		9,162		9,047		9,138	
Delivery charges			262		147		238	
Relative number[1]		72.0		73.7		71.6		71.5
Moline								
John Deere 95	12,357		12,433		12,643		12,773	
Delivery charges			77		286		416	
Relative number[1]		100		100		100		100
International Harvester 403	11,596		11,685		11,852		11,953	
Delivery charges			89		256		357	
Relative number[1]		93.8		94.0		93.7		93.6

Note: Prices at delivery points include delivery charges. The price relatives show the price at each point taken relative to John Deere's price as 100.

[1] Relative to John Deere's prices at destination shown as 100.

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table E.3, p. 200.

For major firms, the cost of borrowed funds is not likely to differ significantly whether they are locating a plant in Canada or the United States. Many of these firms have in the past raised capital in the United States and subsequently used it in many different countries. While the U.S. balance-of-payments guidelines restrict this type of financing at the moment, it is believed that these restrictions will be temporary. Smaller firms would probably pay more for borrowed funds in Canada than in the United States, but no account has been taken of this in the present analysis.

Summary and Conclusions

The over-all impact of manufacturing costs, outbound transportation charges, and corporate tax rates, is summarized in Table 16.15. These data show that for a combine selling at identical delivered prices and shipped to the entire North American market, the manufacturing profit before tax and after deducting outbound transportation charges would amount to 3.33 per cent of the suggested retail price in Brantford, 9.83 per cent in Winnipeg, and 0.91 per cent in Moline. Thus, in terms of profitability, this analysis would give a very considerable locational advantage to Winnipeg, as compared with either Brantford or Moline. The difference between Brantford and Moline, while less, is still comparatively large.

TABLE 16.15–COMPARATIVE COSTS, INCLUDING OUTBOUND TRANSPORTATION COSTS AND PROFITS FOR COMBINE PLANTS IN BRANTFORD, WINNIPEG, AND MOLINE

	Base Price Costs and Profit Data	Adjustments to Actual Locations		
		Brantford	Winnipeg	Moline
Suggested retail price	100.0	100.00	100.00	100.00
Actual price paid by farmers	85.0	85.00	85.00	85.00
Add lowest weighted average transportation cost[1] (from Moline)	–	1.08	1.08	1.08
Price paid by farmer, delivered	–	86.08	86.08	86.08
Actual transportation cost[2] to company	–	(1.75)	(1.53)	(1.08)
Transportation cost penalty	–	(0.67)	(0.45)	–
Transfer price received by manufacturing division from distribution division	61.0	60.33[3]	60.55[3]	61.00[3]
Corporate costs charged to manufacturing, including R&D	(3.0)	(3.00)	(3.00)	(3.00)
Manufacturing costs	(54.0)	(54.00)[4]	(47.72)[5]	(57.09)[6]
Manufacturing profit before taxes	4.0	3.33	9.83	0.91

[1] Estimated as $110, the weighted average transportation costs from Moline, to total North American market on wholesale price of $7,314 or a factor cost of 1.08 in relation to suggested retail price of 100 ($10,158).

[2] Moline as lowest weighted average transportation costs is then adjusted according to Table 16.12, Brantford 100 ($10,158).

[3] 61.0 level transfer price minus outbound transportation penalty.

[4] Taken as "base".

[5] Adjusted to 88.37 per cent of base (Table 16.11).

[6] Adjusted to 105.71 per cent of base (Table 16.11).

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 4.4, p. 53.

It must be emphasized that, with any major shift of the industry towards Winnipeg, union pressure could reduce the relative labour cost advantage that this region now possesses. On the other hand, it was assumed that Winnipeg would purchase its materials and components from the same sources as Brantford and Moline. It is quite possible that even now Winnipeg might be able to substitute components made by local suppliers with some cost advantage over those shown in the study. Moreover, as the farm machinery industry developed in the Winnipeg area, a general growth of the parts-supply industry in this region could be expected. Further, it must be noted that for products sold primarily in the Prairie region of Canada and the United States, the advantage to Winnipeg is even larger.

Ontario has experienced a considerable decline in its share of both the Canadian and the combined Canada-U.S. production of farm machinery. In some measure this has been due to the declining importance of markets outside North America for Canadian firms. In very considerable degree this reflects the great expansion that has occurred in Massey-Ferguson's production facilities in Western Europe and other countries. Markets which this company formerly supplied from its Canadian factories now are supplied locally or from plants in nearby countries. It also reflects the general westward shift of the centre of the market in North America.

Is this downward trend in Ontario's share of North America's production of farm machinery likely to continue? In part this will depend on how the issue of wage parity is resolved. During the last round of wage negotiations carried on between the United Auto Workers and Massey-Ferguson the union was pressing for wage parity with their counterpart workers in the United States, with parity defined as the same wage in Canadian dollars as is paid in the United States in U.S. funds. An estimate of the effects that wage parity defined in this way would have on the competitive position of a farm machinery plant located in Brantford as compared to Moline is given in Table 16.16. As these data show, wage parity for all classes of workers in a Brantford plant would eliminate almost all of the advantage in manufacturing costs that such a plant now possesses as compared with a Moline plant. The Brantford plant would be left with no manufacturing-cost advantage to enable it to offset the outbound transportation cost disadvantage it has throughout much of the North American market. Thus these data support the argument advanced by Massey-Ferguson that wage parity would adversely affect the competitive position of Southern Ontario as a location for farm machinery production. On the other hand, Winnipeg's competitive position would be improved. This conclusion is, of course, dependent on the many assumptions that had to be made in developing this analysis. If a move to wage parity were accompanied, for example, by a move to parity in productivity, Moline's costs would still be about 2 per cent higher than Brantford's.

It should also be noted that if workers in Southern Ontario obtained parity with U.S. workers while wages in the Winnipeg area remained at their present level,

TABLE 16.16 – COMPARABLE PRODUCTION COSTS OF BRANTFORD FARM MACHINERY PLANT BEFORE AND AFTER WAGE PARITY WITH MOLINE PLANT

	Brantford		Moline	Differential	
				Brantford Costs Better/(Worse) than Moline	
Production Costs	Before Parity Cost Adjustments (Table 16.11)	After Parity Cost Adjustments	(No Change from Table 16.11)	Before Parity	After Parity
Material	53.00	53.00	52.46	(.54)	(.54)
Direct Labour					
Wage costs	12.11	12.77[1]	13.81	1.70	1.04
Fringe benefits	3.92	4.14[2]	4.23	0.31	0.09
Total labour	16.03	16.91	18.04	2.01	1.13
÷ Productivity factor	1.00	1.00[3]	1.08	(1.34)[5]	(1.32)[5]
Adjusted total	16.03	16.91	16.70	0.67	(.21)
Overheads					
Salaries (incl. fringes)	6.88	8.81[4]	9.36	2.48	0.55
Indirect labour (incl. fringes)	7.52	9.02[4]	9.63	2.11	0.61
Other	16.57	16.57	17.56	0.99	0.99
Total overheads	30.97	34.40	36.55	5.58	2.15
Total production costs	100.00	104.31	105.71	5.71	1.40
Taking Brantford costs after parity as 100		100.00	101.34		1.34

[1] At .925 of U.S. rate, equalling M-F definition of parity (the then official exchange rate).

[2] Fringe benefit costs increased proportionally to wage rate increase.

[3] Assumed lower productivity than in the United States was retained. If the move to parity had been accompanied by parity in productivity, Canadian direct labour cost would actually have gone down to 15.65 (16.91 ÷ 1.08). Total costs after parity would then show as 103.05, leaving Moline's costs as 102.30 of Brantford's as 100.00.

[4] Table D.3A data adjusted to

	Ontario		Moline
	1966	(Parity)	
Indirect labour wage rate	$2.70	$3.24 ($3.50 x .925)	$3.50
Fringe benefit (increased proportionally with wage increase)	0.87	1.05	1.07
Total	$3.57	$4.29	$4.57
	100.00	120.16 (120)	128.01 (128)
Salaried employees salary	$81.06	$103.57 ($111.97 x .925)	$111.97
Fringe benefit (increased proportionally with salary increase)	26.26	33.56	34.15
Total	$107.32	$137.13	$146.12
	100.00	127.78 (128)	136.15 (136)

[5] Derived number, difference between differential for "total labour" and "adjusted total".

Source: N.B. MacDonald, *Locational Advantages in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 6 (Ottawa: Queen's Printer, 1970), Table 5.3, p. 82.

the cost advantage that Winnipeg now has as compared with Brantford would widen further. Manufacturing costs in Winnipeg would be about 15.5 per cent below their level in Brantford instead of about 12 per cent. The relevant data are as follows:

Total Manufacturing Costs with Brantford Costs Before Parity Taken as 100

	Before Parity with 1968 Salary and Wage Rates	After Parity for Southern Ontario
Winnipeg	88.12	88.12
Brantford	100.00	104.31
Moline	105.42	105.42

This weakening of Southern Ontario's competitive position might well produce a further shift of manufacturing production out of Ontario and into Manitoba and the Prairies generally. This would be especially important for products such as swathers, diskers and chisel plows, which are mainly used on the Prairies.

Tractor Production in Canada

Canada's farm machinery industry is much smaller than it would otherwise be if she had a substantial tractor manufacturing industry. Currently, Canadian production is limited to a small crawler which International Harvester assembles at Hamilton and the large four-wheel-drive tractors that Versatile is producing in Winnipeg. In addition, Massey-Ferguson produces a substantial volume of tractor parts in Brantford and Toronto which are shipped for assembly to the firm's Detroit factory. What are the prospects for increased tractor production in Canada?

This question was analyzed by Massey-Ferguson for their own operations in their submission to the Commission.[5] The company estimated the cost differential that would arise if its Detroit tractor assembly plant and the ancillary transmission and axle plants were moved from Detroit to Brantford. The results of this analysis are shown in Table 16.17. This estimate, which was prepared for Massey-Ferguson by a private consulting firm, shows that the annual cost of operating these plants in Brantford would be about $900,000 higher than in Detroit. Direct operating costs for labour, materials and utilities would be some $2.8 million lower in Brantford. But this would be offset by an additional cost of $2.3 million for inbound and outbound transportation, $1.1 million for relocation and depreciation, and $400,000 for additional duty on exports of industrial tractors.

The occupancy costs—depreciation and relocation—are cost differences that would face Massey-Ferguson if it were considering moving their Detroit facility. However, this is not a cost difference that would face a firm that might be considering locating a new facility in Detroit or Brantford. If these items of cost

[5] Massey-Ferguson Industries Limited, *Brief to the Royal Commission on Farm Machinery*, Ottawa, January 1968, Vol. I, Ch. IV, p. 28.

TABLE 16.17 DIFFERENCES BETWEEN ESTIMATED COST AT BRANTFORD AND ACTUAL COST AT DETROIT OF OPERATING TRACTOR ASSEMBLY, AND TRANSMISSION AND AXLE PLANTS (NOV. 1, 1964 TO OCT. 31, 1965)

(Millions of Canadian dollars)

Costs	Cost Difference Assuming 1965 Brantford Costs	
Direct Operating Costs		
Materials	−0.9	
Labour, hourly and salaried	−1.8	
Utilities	−0.1	
Total direct operating costs		−2.8
Duty on Goods Produced	+0.4	
Transportation Costs		
Inbound materials	+1.7	
Outbound finished products	+0.6	
Total, duty and transportation		+2.7
Other Costs Associated with Relocation		
Relocation	0.7	
Depreciation	0.4	
Total, other costs		+1.1
Total, all cost differences		1.0

Source: Taken from Massey-Ferguson Industries Ltd., *Brief to the Royal Commission on Farm Machinery*, Ottawa, January 1968, Vol. I, Ch. IV, p. 28.

were removed, annual costs at Brantford would be about $200,000 lower than in Detroit. A further unfavourable cost differential for Brantford, the $400,000 for duty, arises because industrial tractors are subject to duty by the United States but are duty-free coming into Canada. The existence of this duty clearly biases the tractor-location decision in favour of the United States. If it were possible through tariff negotiation to remove this duty, the Brantford location would have an over-all advantage of $600,000. Commission staff analyzed the consultant's study which formed the basis of Massey-Ferguson's data, and concluded that the inbound transportation disadvantage shown for Brantford was overstated by about $1 million.[6] When these three adjustments are added together, Brantford shows a cost advantage of $1.6 million.

Thus, for a new tractor plant which had duty-free access to the U.S. market and with the wage differences in effect in 1966, this analysis suggests that Brantford would have a small advantage over Detroit. While the value of output from the Massey-Ferguson Detroit plant is not known, a rough estimate of its output would be $120 million (39,000 tractors at just over $3,000 each). On this basis the cost advantage would be around 1.3 per cent. It would be a larger percentage, perhaps as much as 3 to 4 per cent, of the value added in the plant.

[6] See N.B. MacDonald, *op. cit.*

Despite this small potential advantage for a Southern Ontario location there is little prospect at the moment that a new tractor factory will be located in this area. The prospect would be improved if the Canadian Government could negotiate a removal of the U.S. tariff on industrial tractors. However, even then, the prospect for a new tractor plant would not be good. In terms of number of units, tractor production in North America has been falling. In 1966, for example, the number of tractors produced was only half that of 1952, although the total horsepower capacity of those tractors may well have been larger. In a declining market, with existing firms developing excess capacity, there is little incentive to establish a new plant. Most of the new tractor-production facilities built during the past few years have been located in Western Europe, where costs of production are lower, or in developing countries where tariff or other protection has provided an inducement for their construction.

There is one additional disadvantage faced by a Canadian producer. A Canadian manufacturer of tractors and other farm machinery can buy machinery and equipment on a duty-free basis, but only if it is used entirely for the manufacture of farm machinery. But it may often be economical to combine the production of farm machinery with other products. In the United States, for example, International Harvester produces farm machinery jointly with other equipment, or produces components for both in almost half of all its plants. A Canadian manufacturer cannot obtain the economic advantages that may accrue from these joint production arrangements without forgoing his right to import production machinery and equipment without payment of duty. He is forced to choose between duty-free access to production machinery and the cost advantage of joint production.

The analysis in this chapter has shown that in recent years farm machinery production in Ontario has declined relative to Canada as a whole and to the Canada-United States total. At the same time output in Western Canada, in Quebec, and in the Maritimes has increased. Will these trends continue? Analysis of the relative locational advantages of Winnipeg, Brantford, and Moline suggests that Winnipeg currently enjoys a considerable advantage over the other two areas. At current wages and exchange rates (1969) Brantford has a slight advantage over Moline but most of this is needed to absorb the outbound transportation penalty it must face. Any further move towards wage parity would seriously weaken its competitive position.

In the short run, of course, the industry continues to produce in its existing facilities even though the economic advantages of that location has changed. And when–as is true of farm machinery–the industry's total output has grown very slowly (total output in 1966 was only slightly higher than the earlier peak reached in 1949), few new plants are built and the scope for changing the industry's location is more limited. When Massey-Ferguson was asked why it produced its swathers and diskers in Toronto, even though both these machines are used almost entirely on the Prairies, the company replied that it was able to build these in its existing

facilities in Toronto in what would otherwise be idle capacity. Still, it would appear that there is room for a very substantial further growth in production on the Prairies, since its current output is still small relative to the North American total--a little over 1 per cent. The very recent growth of output in the Maritimes reflects the efforts of one enterprise that specializes in potato equipment. There are undoubtedly opportunities in all parts of Canada for specialization in equipment related to particular regional specialties. Something further will be said on this matter in the chapter on research and development.

Chapter 17

RESEARCH AND DEVELOPMENT

Over the past few decades major technical changes have occurred in the farm machinery used on Canadian farms, and these changes have had far-reaching effects on the productivity, structure, and organization of Canadian farming. The self-propelled combine and 100 HP tractor of 1969 are a far cry in sophistication and productivity from the binders and threshing machines of the twenties and thirties. What has been the source of these changes? How much do they owe to the individual farmer-inventor; how much to the research laboratories of industry, universities or government; how much to the genius of gifted inventors; how much to research carried out in other industries? Throughout the world there has been increasing emphasis on research and development. In many Canadian industries the first formal R&D units were set up within the past few years. What is the situation in the farm machinery industry? Is the industry's R&D expenditure adequate? Is an appropriate amount of the research expenditure taking place in Canada? Are Canadian governments and universities fulfilling a proper role? Does the individual farmer-inventor receive enough encouragement and protection in an age of large-scale industrial research? How does one decide on the amount of money that should be devoted to research? This chapter will attempt to answer some of these questions and in doing so will examine in some detail the role of research and development in the farm machinery area.

In assessing the significance of these R&D expenditures, three rather different considerations must be kept in mind. First, what effects do they have on the location of farm machinery manufacturing facilities? Would an increase in Canadian expenditures on research lead to a significant growth in the Canadian industry? Or is there little relation between the location of research and the location of manufacturing? In respect to these questions, does it matter whether these increased expenditures are made by industry, by government, or by universities? Second, what effect does R&D expenditure have on the pattern of competition in the industry? Do the large research programs of the major firms give them competitive advantages over smaller firms, with the result that the whole industry is made less competitive? Would additional government or university research help offset the advantage gained by the dominant firms and thus

contribute to the maintenance of a competitive industry? Third, what contribution can R&D expenditures make to improving the economic position of Canadian agriculture? Are industry research expenditures adequate for this purpose, or should they be supplemented by university and government expenditures? The first and third points will be examined in this section. The second point is considered in Part II of this Report, where the pattern of competition in the farm machinery industry is examined in some detail. Before proceeding to examine these questions, the present pattern of research expenditures on farm machinery in Canada, and to some degree throughout the world, will be outlined.[1]

The Present Pattern of Farm Machinery Research

While information on R&D expenditures on farm machinery in the past is sketchy and incomplete, evidence suggests that prior to 1945 most of the expenditures in this area were carried out by industry, and these expenditures were relatively modest in size. Massey-Harris is reported to have spent an annual average of $361,000 for research from 1925 to 1929, or about 1 per cent of sales. Despite the sharp decline in sales during the thirties, expenditures were increased to a level of $510,000. It was during this period that Massey started the research that led in a few years to their highly successful self-propelled combine. Research expenditures on farm machinery by Canadian governments or universities in this period were virtually non-existent.

In the North American industry's early history--say, prior to 1920--most of the major new developments were the result of the efforts of farmers or other individuals. In some cases, as was true of Deere and McCormick, the individual began to manufacture and sell his invention and thus formed the basis of a highly successful business. Other individuals patented their inventions and sold them or licensed them to someone else to manufacture. Rarely were these inventions completely new. Both the McCormick reaper and Deere's steel plow had been preceded by a long series of experiments on the part of many different individuals. In this early period, too, patent suits between competing companies were a common feature of the industry.

In the period between the two world wars, the inventions of individual farmers continued to be important, but the R&D expenditures of the major firms gradually increased in importance. International Harvester's success in recapturing a large share of the U.S. tractor market in the mid-twenties was based on its development of the all-purpose tractor. However, very little data are available on the size of these R&D expenditures. Brilliant individuals also made important contributions in this period, the most notable example being Harry Ferguson, who

[1] A detailed study of the subject, *Research and Development in the Farm Machinery Industry* by A. G. Vicas, was published in 1970 by the Royal Commission on Farm Machinery, Study No. 7 (Ottawa: Queen's Printer, 1970).

developed the three-point linkage which made it possible for a lighter, less expensive tractor to perform the work of a much heavier and more costly machine. Now called the Ferguson system, this development was eventually adopted by almost all manufacturers.

The postwar period has seen a rapid growth in R&D expenditures by the major manufacturing firms. The three largest firms on a worldwide basis reported expenditures in 1969 as follows: Deere & Company, $48 million–4.6 per cent of sales; International Harvester, $85 million–3.2 per cent of sales; and Massey-Ferguson, $26 million–2.5 per cent of sales. It is clear that in absolute amount these expenditures are now very large. Much of this growth has been relatively recent. Deere & Company reported that its R&D expenditures had increased almost four times between 1955 and 1965. While most of the industry's research is applied research and oriented to fairly short-term developments, within recent years the industry has begun to devote some resources to more basic research. In 1963, Deere & Company set up a basic research unit to explore some of the principles underlying the operation of farm machines. At the time the Commission visited this unit in 1967, it employed 170 people, of whom some 70 were professionally trained–17 with doctorates. Some examples of the type of research then under way were as follows: an aerodynamic study of air flows in a combine, the influence of the earth's magnetism on plant growth, and precision planting of vegetable seeds to eliminate the need for thinning. Some further data on R&D expenditures, related to all products, by each of the three major international companies are given in Table 17.1.

One survey of research and development expenditures in the United States ranked farm machinery and equipment thirteenth among the manufacturing industries in terms of the ratio of its R&D to value added.[2] However, almost half of the industries that ranked above it were heavily involved in defence or space programs, with R&D strongly supported by the federal government. If the ranking had been based on privately financed R&D expenditures, the farm machinery industry undoubtedly would have placed much higher. The farm machinery industry's total research and development expenditure was reported as $75 million in 1960. If the industry total increased at the same rate as that reported by the three major firms listed in Table 17.1, this figure would have reached $130 million by 1967. No data are available which would indicate how much of the industry expenditure in this field is research as opposed to development. Given the very limited amount of basic research carried on by the industry, it seems likely that the total program is strongly oriented to development.

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[2] N. E. Terleckyj, *Research and Development: Its Composition and Growth,* National Industrial Conference Board, New York, 1963, p. 85.

TABLE 17.1–RESEARCH AND DEVELOPMENT EXPENDITURES AS PERCENTAGE OF SALES OF ALL PRODUCTS, MAJOR FARM MACHINERY MANUFACTURERS, 1960-69

(Millions of dollars)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
					(U.S. dollars)					
Deere & Company										
Net sales	511.9	561.6	572.8	688.9	816.6	886.6	1,062.1	1,086.4	1,030.5	1,043.3
R&D expenditures	22.9	21.6	25.5	27.0	n.a	39.0	42.0	46.0	49.0	48.0
Percentage of sales	4.5	3.8	4.4	3.9	n.a	4.4	4.0	4.2	4.7	4.6
					(Canadian dollars)					
Massey-Ferguson Limited										
Net sales	490.4	519.3	596.1	685.7	772.0	808.5	932.1	913.3	916.8	1,043.4
R&D expenditures	11.7	13.1	14.0	16.1	17.4	19.1	21.3	24.7	23.8	26.4
Percentage of sales	2.4	2.5	2.3	2.3	2.3	2.4	2.3	2.7	2.5	2.5
					(U.S. dollars)					
International Harvester Company										
Net sales	1,683.2	1,611.9	1,837.2	1,957.4	2,190.4	2,336.7	2,583.0	2,541.9	2,540.0	2,653.0
R&D expenditures	52.0	55.4	54.4	58.0	58.4	63.8	71.0	78.0	80.5	85.0
Percentage of sales	3.1	3.4	3.0	3.0	2.7	2.7	2.7	3.1	3.2	3.2

Note: In addition, Allis-Chalmers reported R&D expenditures of U.S. $25 million in 1961 or 5.0 per cent of total net sales; White Motor reported R&D expenditures of U.S. $9 million in 1967 or 1.2 per cent of net sales. Massey-Ferguson's R&D expenditures averaged Can. $7.6 million for the years 1957 to 1959 or 1.8 per cent of net sales.

Source: *Annual Reports* of companies.

In order to provide data on the pattern of farm machinery research in Canada the Commission surveyed the major firms in the industry, as well as universities with agricultural engineering departments. The results of this survey are summarized below.

Research and Development in Canada: The Industry

Research and development facilities in the Canadian farm machinery industry go back more than 60 years. International Harvester established an engineering department in Hamilton in 1906, and Massey-Harris set up a permanent R&D unit in 1918. Even before that time, Massey had been responsible for a number of important developments, particularly in binders and combines, and these had helped it establish its large export business. John Deere set up an experimental engineering department at its Welland works in 1948. Less is known about the old Cockshutt company, although it is clear that it had a significant research effort. Two of its more notable contributions were the "tiller combine" developed in the twenties and the continuously running power-take-off introduced shortly after the Second World War.

Although the industry's research and development activities have a long history in Canada, total expenditures are still comparatively small judged either in relation to total sales of farm machinery in Canada or in relation to the value of manufacturing shipments. In recent years R&D expenditures have been little more than 1 per cent of total industry sales and between 1 and 2 per cent of the value of manufacturing shipments (Table 17.2). In contrast, most of the major U.S. firms spend something in the range of 2.5 to 4.0 per cent of their annual sales on research and development. Further, in 1966, almost half of the industry's total expenditure in Canada, \$4.7 million, was accounted for by one company, Massey-Ferguson. If Massey-Ferguson is excluded from the industry total, R&D expenditures by the industry in 1966 amounted to little more than one-half of 1 per cent of total sales. Another major firm, International Harvester of Canada, reported R&D expenditures covering their entire Canadian operation, which includes trucks and industrial equipment as well as farm machinery, at just under \$2 million in 1966 or about 0.8 per cent of its annual sales. This contrasts with the average level of 2.9 per cent of sales reported by their parent company over the period 1960 to 1967. Even Massey-Ferguson, although its ratio of research expenditures to sales in 1966 was slightly higher in Canada (2.7 per cent) than in the United States (2.1 per cent) or the rest of the world (2.4 per cent), had a significantly lower ratio of R&D expenditures to manufacturing shipments in Canada than was true for the United States or all other countries. The number of people employed by the company in manufacturing and engineering is three times as large in Canada as in the United States; yet Massey-Ferguson spent only \$2.6 million on research in Canada compared with \$6.2 million in the United States.

When the research expenditures of the four major firms are examined, some support is given to the hypothesis that increased expenditures on research in Canada lead to a larger volume of manufacturing. In general, the data show that the larger the ratio of research expenditures to the value of manufacturing shipments in Canada, the larger the firm's total shipments.

TABLE 17.2 - CURRENT EXPENDITURES ON RESEARCH AND DEVELOPMENT, FARM MACHINERY INDUSTRY, CANADA, 1955, AND 1960-66

		Ratio of Current Expenditures to:	
	Expenditures	Manufacturing Shipments	Wholesale Sales
	($'000)	(Per cent)	(Per cent)
1955	1,632	1.3	0.9
1960	3,005	1.7	1.2
1961	2,843	1.9	1.2
1962	3,202	2.0	1.1
1963	3,457	1.7	1.0
1964	4,057	1.6	1.1
1965	4,285	1.5	1.0
1966	4,702	1.4	1.0

Source: Commission survey. Data are approximate only; for earlier years, data had to be estimated for some companies, and the allocation of expenditures between farm machinery and other products was based in some instances on numbers of professional personnel.

Information on the research and development personnel employed by the Canadian companies suggests that their level of professional training is somewhat below that of comparable research units in the United States. In Canada, most professional research personnel had a bachelor's degree in engineering or its equivalent; no doctorates were reported, and there were only a very few masters' degrees. In contrast, in three U.S. companies for which data were available, 14 per cent of their research personnel had advanced degrees and 4 per cent had degrees outside the engineering field. In 1966 the Canadian industry employed the full-time equivalent of 39 professionals in a research and development capacity. In addition, there were 12 administrators with professional training, and 394 supporting personnel. Nearly all of these were in the large firms. Among the smaller firms, R&D is often carried on by people with practical experience but without professional training. For example, as of 1968, C.C.I.L. employed no graduate engineers, and Versatile employed only one. Yet both these firms have a substantial volume of production, and are continuously engaged in product development.

The industry's Canadian research has been heavily concentrated on combines in particular, and harvesting equipment in general. In 1966, combines accounted for 38 per cent of all R&D expenditures, other harvesting equipment for 28 per cent, and tillage equipment for 12 per cent.

Research and Development: The University Sector

Compared with the amount spent by private industry, R&D expenditures by Canadian universities have been very small indeed. As Table 17.3 shows, only in 1961-62 did total expenditures exceed $100,000, and in the latest year for which data are available, 1965-66, the total amounted to only $225,000—less than 5 per cent of the research effort of the Canadian farm machinery industry. More than half of this total represented a share of departmental budgets, judged to be for the support of research rather than teaching or extension. Research supported by a separate budget amounted to less than $100,000 in 1965-66, and more than half of this was at the University of Saskatchewan. Industry support to Canadian universities in the period covered was limited to one project at the University of Guelph, with an annual grant of only $2,500. In contrast, in the United States, the industry provides extensive support to university research.

TABLE 17.3 – CURRENT EXPENDITURES ON FARM MACHINERY RESEARCH AND DEVELOPMENT, CANADIAN UNIVERSITIES, SELECTED YEARS, 1949-66

(Thousands of dollars)

	Budgeted R&D	Departmental R&D	Total R&D
1949-50	3.2	16.3	19.5
1954-55	8.5	42.0	50.5
1959-60	16.8	67.0	83.8
1960-61	14.2	71.1	85.3
1961-62	19.4	82.4	101.8
1962-63	9.7	91.6	101.3
1963-64	15.8	111.3	127.1
1964-65	11.5	116.7	128.2
1965-66	95.6	129.2	224.8

Source: Data provided to the Commission by eight universities and colleges.

The Commission's survey also indicated that research in the agricultural engineering departments of Canadian universities is severely limited by the heavy teaching loads that exist in almost all universities. Teaching loads involving 14 to 16 classroom hours per week are still common, compared with six to nine hours in many other university departments. Only one university, Saskatchewan, reported that it had a policy of reducing teaching loads to support larger research commitments. The department at the University of Saskatchewan also reported the most extensive list of research projects among Canadian universities.

In its submission to the Commission, the National Committee on Agricultural Engineering expressed the view that: "The professional manpower devoted to research and development of agricultural engineering in Canada is wholly inadequate to serve the needs of the agricultural industry. Aside from the University of Guelph which has 22 engineers in a growing School of Agricultural

Engineering and the University of Saskatchewan with 18, it is doubtful whether any other organization has a sufficient number of engineers to constitute a 'reactive mass'." Only three Canadian universities offer a Ph.D. in agricultural engineering, and these programs were established only very recently. The National Committee also reported that there were currently in Canada about 50 students graduating in agricultural engineering and about 30 studying for advanced degrees.

Not only is the current research effort of Canadian universities in the farm machinery field small in comparison with private industry, it is also small compared with the research effort in American universities or in comparable institutions -for example, in West Germany. In 1966, research on farm machinery conducted in the State Agricultural Experiment stations attached to land-grant colleges and state universities in the United States amounted to $3,388 million. The comparable figure for Canadian universities is $95,600, about 2.8 per cent of the American total. Indeed, the total U.S. research expenditure on machinery related to peanuts was larger than the entire Canadian university effort. The U.S. program related to farm mechanization is discussed further in the next section.

While no complete data are available on the research programs of universities in West Germany, the Commissioner visited the agricultural engineering departments in two universities and in both cases found large well-equipped laboratory facilities and substantial research budgets. The Department of Agricultural Engineering at the University of Bonn reported a research budget of $37,500 and was currently engaged in research on sugar-beet planting, thinning, and harvesting equipment. Similarly, the Institut für Landmaschinen der Technischen Hochschule at Braunschweig reported a budget of $62,500. Basic research projects under way in this department included hay wafering, analysis of the stresses within a hay-baler, and hydrostatic transmissions. In West Germany as a whole there are four engineering-type schools with departments of agricultural engineering comparable to the one visited at Braunschweig, and seven departments associated with agricultural colleges, similar to the one visited at Bonn.

Research and Development: The Government Sector

Until very recently, support for research and development in farm machinery by Canadian governments has been almost non-existent. The Canada Department of Agriculture has for years had a small farm machinery unit, but the Department's annual reports suggest that its purpose was envisaged more as one of building research equipment for scientists in other areas than of carrying out research aimed at the development of new types of farm machinery. A survey completed in 1966 showed that, measured by professional man-years, agricultural engineers accounted for only 1.3 per cent of the Department's research staff and many of these would be engaged in research connected with irrigation, drainage, farm structures, and crop storage rather than farm machinery proper. The situation in the provinces has been little better. Before an expanded program of agricultural engineering research

was begun in 1966, the total intramural research program on farm machinery amounted to about two professional man-years at the Canada Department of Agriculture and about one professional man-year in *all* provincial departments. Indeed, the various departments of agriculture have been much more active in non-farm machinery engineering projects than in farm machinery projects.

A Special Committee on Agricultural Engineering set up by the Canadian Agricultural Services Co-ordinating Committee to study the need for more research in agricultural engineering reported the need for an expanded effort in all areas of the field. With its effort in 1965, the Committee reported, Canada was not able to even keep up with the latest developments in the United States and other countries. They also emphasized the need for training more Canadians in the field at both the graduate and post-graduate level. The Committee recommended a program of research grants beginning at $50,000 in 1966-67 and increasing by $25,000 a year for the following four years. The grant program was to be co-ordinated by a national committee and was intended to promote research and development in agricultural engineering at universities across Canada, and at Canada Department of Agriculture research stations, experimental farms, and in other similar bodies.

Although the Committee did not favour a strong central research institution, it recommended that a Technical Information and Liaison Unit be developed in the Canada Department of Agriculture whose functions would be to "provide information on agricultural engineering developments in the United States, Europe and elsewhere to maintain a technical reference file; to aid in the study and evaluation of agricultural engineering problems in any province, and to share responsibility for recommending R&D projects to solve these problems; to aid in maintaining liaison among regional centres, and especially with the agricultural engineering industry; and to prepare reports, abstracts, articles, and other publications, serving the engineering needs of the agricultural industry". The proposal called for one engineer to head the unit, a staff of five engineers and other supporting personnel, and an annual budget of about $150,000. Thus the Committee's expanded program called for an annual expenditure of around $300,000 to cover both its proposed research-grant program and its liaison and information services unit.

Even in terms of the proposed expansion the total effort appears small. Consider, for example, the situation in Britain where the National Institute of Agricultural Engineering has an annual budget of about $2 million, of which roughly three-quarters is devoted to the support of research and one-fourth is spent on testing. Thus the Institute has available a research budget about five times the size of the increased expenditure level proposed for Canada. The Institute employs about 360 people at its central station at Silsoe and about 40 at its Scottish station. About one-third of its employees are at the scientific level. Of these, some 30 per cent are basic engineers, 20 per cent are agricultural engineers, 40 per cent are agriculturalists with an interest in farm mechanization, and 10 per cent from other scientific disciplines such as physics, botany, and mathematics.

Similar farm machinery research institutes can be found in a number of countries in Western Europe. In The Netherlands, the Institute of Agricultural Engineering and Rationalization at Wageningen engages in extensive machinery research, has a research staff of about 150 professional people and an annual budget of around $700,000. In Prague the Commission saw a well-equipped research institute that employed about 350 people and was carrying out an active program of research on machinery related to Czech agriculture. In West Germany, the government has established a machine design and development institute at Braunschweig which is pursuing a research program designed to provide more basic knowledge of all problems connected with farm machinery. Farm machinery research institutes also exist in Denmark, Sweden, Finland, and the Soviet Union.

The United States Department of Agriculture (U.S.D.A.) maintains a number of research stations which have major programs related to farm machinery. In addition, the Federal Government is a major supporter of the research carried out by the State Agricultural Experiment stations. A summary of the research effort on farm machinery by these two groups is given in Table 17.4. As these data show, total expenditures in 1966 amounted to just under $6 million, with $3.4 million of this carried out at the State Experiment stations and $2.4 million within the U.S.D.A. This program involves an estimated 165 scientist man-years. Almost one-third of the total program involves research related to fruits and vegetables. While this research program is large in absolute size, and very much larger even on a relative basis than the equivalent Canadian university and government research program, it is still small compared with the total U.S. agricultural research effort. Thus, in terms of dollars of expenditure, it is estimated that research in relation to agricultural machinery amounts to only about 1.6 per cent of the total research carried on by the U.S.D.A. and the State Agricultural Experiment stations. Measured by the number of scientists involved, the share of research related to mechanization is slightly larger, about 2.8 per cent of the estimated 6,000 scientist man-years involved in the total agricultural program.

TABLE 17.4–RESEARCH AND DEVELOPMENT SUPPORT FOR FARM MECHANIZATION, U.S. GOVERNMENT AND LAND-GRANT COLLEGES, 1966

	U.S.D.A.		State Agricultural Experiment Stations		Total	
Crop	SMY[1]	Dollars ('000)	SMY	Dollars ('000)	SMY	Dollars ('000)
Fruits and vegetables	14.7	428.5	50.3	1,470.0	65.0	1,898.5
Field crops	40.2	2,010.9	60.6	1,918.2	100.8	3,929.1
Total	54.9	2,439.4	110.9	3,388.2	165.8	5,827.6

[1]Scientist man-years.

Source: Data supplied by U.S. Department of Agriculture.

Having surveyed the present state of farm machinery research and development in Canada and compared it with the situation existing in the United States and a number of European countries, let us now consider the two basic questions raised at the start of this chapter. What contribution can research and development make to the viability and growth of the Canadian farm machinery manufacturing industry? What effect can it be expected to have on the competitive position of Canadian agriculture?

Research and Development and the Growth of Canadian Manufacturing

In recent years a number of economists have argued that a country's comparative advantage in international trade in particular products is often closely related to the level of its research effort in these products. This is particularly likely to be true for recently developed products, or products whose technology is changing rapidly. Thus the fact that the United States leads the world in the export of computers and jet aircraft undoubtedly reflects the large amount of government-supported research in a variety of related fields. If the product is still changing rapidly, the manufacturer will want to establish his production facilities close to his research and development facilities so that consultation on production problems, or problems that develop when the product is in use, can be more easily carried out. Even within a country there is some evidence that a strong R&D effort will encourage the growth of science-oriented industries near research centres. The growth of many science-oriented firms in the region surrounding Boston undoubtedly owes much to the strong R&D effort that is maintained by universities in this region. Not only are the individuals involved in these research programs available to advise firms producing science-oriented products, but many firms may be started by individuals who gained their initial knowledge working on research programs.

What application does this have to the farm machinery industry in Canada? Would an increased R&D effort on farm machinery encourage the growth of more manufacturing in Canada? There are strong reasons for believing it would. Although one executive in a medium-sized company argued before the Commission that there was no necessary relation between the location of research program and where the products developed by that program were subsequently manufactured, the whole pattern of the industry's growth in North America contradicts this assertion. Most of the research and development programs in the industry are attached to the plants manufacturing the products under investigation. Massey-Ferguson's concentration of a disproportionate amount of its North American research effort near Detroit may appear to be an exception to this pattern. But this location, too, is partially explained by factors closely related to research. It was explained to the Commission that Detroit has been a more favourable research environment for farm machinery than Brantford and Toronto because there are a number of major universities nearby (University of Michigan, Michigan State University, Ohio State University) that have large graduate programs and university

faculty engaged in research in agricultural engineering and a variety of related fields. In contrast, it is only very recently that the University of Guelph began to offer a doctor's degree in agricultural engineering. It is worth noting too, that White Motor's acquisition of the Cockshutt firm and its subsequent specialization in the production of combines was least partially explained by the fact that White needed an improved combine for its Oliver and Minneapolis-Moline product lines, and Cockshutt had a combine with a good reputation. Further, Cockshutt had just completed a major new product-development program on their combine.

The failure of any of the major firms to establish a manufacturing facility in Western Canada, despite the fact that two-thirds of the Canadian market is located in that region and the fact that production costs in the area are favourable, is another piece of evidence that points in the same direction. One of the region's handicaps has been its distance from any significant research and development effort.

This Commission was asked to recommend measures that would improve the competitive position of the Canadian manufacturing industry. It seems clear that one of the most significant steps the government could take to achieve this end would be to greatly strengthen the research and development effort on farm machinery in Canada. As will be pointed out below, there is strong reason to believe that the benefits obtained from improvements in farm machinery in the past have been very large. This suggests that future benefits could still be very substantial and would fully justify the cost of an expanded research effort.

An expansion in research effort is required at all three levels of industry, government and university. Attempts to encourage an increase in the research effort of industry alone is unlikely to be fully effective, for industrial research is likely to flourish best in the atmosphere created by an active university research effort, especially if the latter is supported by a good graduate-student program. It is in this area that Canada has fallen down most seriously in the past and it is in this area that it is still seriously deficient. Moreover, the very fact that the major portion of research and development on farm machinery has been concentrated in the industrial sector in the past has also meant that the interdisciplinary side of the program has failed to receive sufficient emphasis. Of all institutions, the university is the one that is in the best position to achieve the interrelation of different fields -of soil mechanics, plant growth, mechanical engineering, agricultural economics, and so on- that a good farm machinery research program requires. An expanded R&D effort in Canadian universities and an increased emphasis on graduate-student training would also greatly increase the supply of people with engineering and other knowledge related to farm machinery. One of the most significant features of the current Canadian picture in this field is the very limited number of people outside the industry with training and experience in farm machinery engineering. As a result, the small company or the individual farmer-inventor has no easy access to technical knowledge in the field. This cannot but handicap the growth of the small independent farm machinery manufacturer.

Universities would be expected to concentrate their research and development on the expansion of basic knowledge with respect to the behaviour and characteristics of different farm machines and their components. Particular attention should be paid to Canadian climatic and soil conditions and the machines suited to the crops grown in Canada. Private firms cannot be expected to spend an adequate amount on basic research. Their research programs are affected by the consideration that they must be able to anticipate the recovery of the cost of their research through the sale of improved farm machines to the farmer. Yet much of the benefit of their research may be shared by other firms or may be passed on to the farmer or to society in general in the form of lower farm production costs. Hence the need for public support of basic research in this area. There is also a special need for public support of research on specialty crops and products. For in these areas the market for any new improved machine is typically so small that the industry cannot afford to devote a significant amount of research funds to its development. Yet the potential benefit to society in the form of reduced production costs may often be substantial.

With an expanded research and graduate-student program at Canadian universities, what role should be envisaged for farm machinery research at the government level? The Information unit recently established in the Canada Department of Agriculture, designed to provide up-to-date information on developments in farm machinery in other countries, is a sound development.

The research and new product development programs currently taking place in industry, in government establishments, and in universities throughout the world, but especially in the United States and in Western Europe, are, in absolute size, very large. A very considerable effort is required just to keep informed on new developments and to evaluate machines and machine practices for their applicability to Canadian agriculture. However, this task can be most effectively performed if there is at least a moderate-sized research program carried out in association with it. An active involvement in research is also needed if the Agricultural Engineering Research unit which will be proposed later in this Report is to be able to effectively co-ordinate the research programs carried on in Canadian universities.

There is also need to encourage an expanded research and development program on the part of the farm machinery industry in Canada. Currently, with one exception, R&D expenditures in Canada by all the major firms are much smaller in relation to sales or manufacturing than is true for the United States. Unless there is an expansion of such activity in this country, Canada is unlikely to receive the share of North American manufacturing that her locational and competitive advantages justify. The Government of Canada has introduced over the past few years a number of programs designed to increase the research and development expenditures of Canadian industry. At the time of the Commission's hearings in late 1967 and early 1968, no farm machinery manufacturer had been able or willing to take advantage of any of these programs. In part, this reflects a weakness in the programs' conception. Discussion with farm machinery executives suggests that the

definition of "scientific research" which must be met to qualify for support under the tax- or grant-based general incentive programs is such that most of the R&D expenditures normally carried on by the farm machinery industry are excluded. Consideration will need to be given to making the definition less restrictive. In respect to the Program for the Advancement of Industrial Technology, it is less clear why the industry has not taken any advantage of it. The program is newer and it may be that firms have not yet had time to develop worthwhile proposals. But its relative failure in the farm machinery industry to date suggests that still further or different incentives will be required if a significant expansion of the industry's Canadian research effort is to take place.

Accordingly, it is recommended that the government review its requirements for research support under its general incentive programs to see whether these requirements cannot be better adapted to the kinds of research normally carried on in the farm machinery industry. It is also recommended that the Department of Industry, Trade and Commerce explore at some length with the various firms in the industry the potential application of the Program for the Advancement of Industrial Technology. However, the most important step that can be taken to increase the R&D efforts of the Canadian industry is to create a research environment in Canada that will encourage the major firms in the industry to expand their own programs. Specific recommendations to this end will be made in the next section of this chapter.

An expansion in R&D expenditures on farm machinery should do much to encourage the growth of the Canadian farm machinery manufacturing industry. However, there are other areas where the knowledge and skills needed to support the growth of Canadian manufacturing are deficient, and the Commission's attention was forcibly drawn to one of these. As part of its research program, the Commission initiated a study of farm tractor manufacturing costs.[3] To find a firm of consultants capable of carrying out a study of this kind it was necessary to go to United Sates.[4] A consulting firm with the kind of knowledge and information required to conduct such a study was simply not available in Canada. It is recommended that the Department of Industry, Trade and Commerce explore thoroughly the kinds of management consulting and advisory services available to Canadian industry, and take any steps deemed advisable to improve the range and depth of these services.

Research and Technology and the Competitive Position of Canadian Agriculture

Farm machinery is a major part of the capital used by Canadian agriculture, and the improvements in this machinery resulting from the inventions of individuals or the research and development carried on by industry, universities, and

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[3]N. B. MacDonald, W. F. Barnicke, F. W. Judge, and K. E. Hansen, *Farm Tractor Production Costs: A Study in Economies of Scale*, Royal Commission on Farm Machinery, Study No. 2 (Ottawa: Queen's Printer, 1969).

[4]The firm in question has since established a Canadian office.

government, can significantly reduce the cost of agricultural production. Where improvements are widely adopted, much of the benefit from these improvements may be passed on to the consumer in the form of lower prices for food or fibre. However, to the degree that improvements are particularly suited to Canadian agriculture, a significant share of these benefits can be expected to accrue to the Canadian farmer. Thus, while the flow of new technology coming from other countries may often be adopted by Canadian farmers, these same farmers rather than Canadian consumers may be the group that has suffered most from the lack of a larger indigenous R&D effort.

TABLE 17.5–AN ESTIMATE OF THE BENEFITS OF IMPROVED FARM MACHINE TECHNOLOGY, CANADA, 1926 AND 1966

	1926	1926 adj.	1966
Improved acreage ('000)	75,175	108,154	108,154
Machinery repairs and depreciation ($'000)	72,525	104,300	550,167
Other machinery expenses ($'000)	53,370	76,800	339,074
Total machinery expenses	125,895	181,100	889,241
Total at 1961 prices ($'000)		369,000	855,000
Labour employed ('000)	1,251	1,802	544
Machinery employed–net at 1961 prices ($million)	1,068	1,540	3,011
Horses ('000)	3,361	4,850	386
Cost of maintenance of horses ($'000)		276,000	22,000
Total operation and depreciation at 1961 prices ($'000)		645,000	877,000
Return on capital invested in horses and machinery at 10 per cent ($'000)		219,000	306,000
Total operation, depreciation and capital return ($'000)		864,000	1,183,000

Estimated value of labour saved:
at farm wages 840,000 at $2,800 = $2,352 million
at non-farm wages 840,000 at $4,000 = $3,360 million
Estimated net benefit annually from farm machinery technology:
valued at farm wages $2,352 – $320[1] = $2,032 million
valued at non-farm wages $3,360 – $320[1] = $3,040 million

Note: "1926 adj." gives 1926 data adjusted for the increase in improved acreage from 1926 to 1966. Data on machinery depreciation and operating expenses are as given in Dominion Bureau of Statistics reports on Net Farm Income and were deflated by the price index for farm machinery and the price index of petroleum products. The cost of maintenance of horses was estimated at 3.8 acres per horse, valued at $15 per acre. Horses were valued at 1961 prices of $133 per horse. It was assumed that 418,000 of the 1,258,000 reduction in farm labour requirements was unpaid family labour.

[1]The $320 million represents the difference in total operating, depreciation and capital-return costs shown in columns 2 and 3.

Source: Commission estimates.

While no precise measurement can be made of the benefits that have resulted from improvements made to farm machinery in the past, a rough estimate of their magnitude is presented in Table 17.5. This estimate compares the position of

Canadian agriculture for the years 1926 and 1966. The estimate is based on the assumption that the reduction in labour requirements in Canadian agriculture over this period is almost entirely a result of improvements in farm machinery technology, where this technology is broadly interpreted to include improvements in materials-handling and building design for livestock, poultry, and milk production as well as field machinery. In some measure this may be an underestimate of total benefits, since the improved equipment now available has undoubtedly also been reflected in higher yields and in improved quality. For example, the farmer's ability to seed, cultivate, and harvest his crop more rapidly with the large-scale power equipment now available has allowed him to time his operations so as to obtain higher yields and avoid the deterioration in quality that often occurred with earlier methods.

Since the acreage under cultivation was much smaller in 1926, the magnitudes for labour and capital in 1926 were increased in proportion to the increase in total acreage of improved land over the 40-year period. Thus, taking the 1966 acreage of improved land as a base, a comparison is made between the 1926 levels of labour, capital, and technology and those in existence in 1966. There have, of course, been many other changes in agricultural technology over this period. These include the use of improved varieties of grains and livestock, increased inputs of fertilizer, herbicides and insecticides, and so on. Invariably these changes have been reflected in increased yields rather than reduced labour requirements. In fact, the higher yields taken by themselves would involve increased labour requirements. This, again, is a reason for supposing that the estimate in Table 17.5 underestimates the benefits of improved technology.

Using this approach, it is estimated that total labour requirements over the period declined by 1,258,000. Recent experience suggests that about one-third of this decline represents unpaid family labour. Omitting this entirely, we are still left with a decline in farm labour requirements of 840,000 between 1926 and 1966. If this labour is valued at the wages of farm labour in 1967 of $2,800 a year, it gives a gross annual benefit of $2,352 million. To arrive at an estimate of net benefits, a deduction was made for the increased operating, maintenance, and depreciation costs of the farm capital and horses in use in 1966, compared with the amount that would have been required to operate the 1966 acreage on the 1926 basis of farming. A similar deduction was made for the increased cost of providing an estimated 10 per cent return on the capital equipment and horses in use in 1966. On this basis of estimation the annual net benefit from the improvements that have occurred in farm machinery technology over the period amount to over $2 billion. If the labour saved is valued at non-farm rather than farm wages, say at $4,000 per annum, this net benefit is increased to around $3 billion. Thus it can be concluded that inprovements in farm machinery technology over this period provide a net benefit to the Canadian economy of the order of $2 to $3 billion annually.

Clearly, the benefits from past improvements in farm machinery in use in Canada have been extremely large. The improvements were derived from many

different sources. Some, such as the swather and disker, were originated by individual farmers. Others, such as the Ferguson system, were the product of brilliant inventors. Still others, such as the self-propelled combines, were produced by the research teams of the farm machinery manufacturers. Research in the automobile and other related industries has also made a contribution.

Given the large size of past benefits it seems reasonable to expect that there are still substantial benefits to be derived from further research. And given the relative neglect of farm machinery research in Canada in the past, particularly by governments and universities, one must suppose that many peculiarly Canadian problems have received little attention. But how does one decide what is a reasonable research effort?

The total research expenditure of the Canada Department of Agriculture for 1969-70 is budgeted for $41 million. Out of this total only about $425,000 is planned for expenditure on farm machinery. Yet for Canada, over the period 1926 to 1966, the benefits from improved farm machinery probably exceed the benefits from all other agricultural improvements. The size of these benefits, at $2 to $3 billion, is larger than the annual net income produced by Canadian agriculture. And the benefits from other agricultural improvements must somehow be reflected within net farm income. On this basis one might argue that half of Canada's total agricultural research effort should go towards the improvement of machinery and equipment. However, it would not be possible to reorient the total research effort to this extent except over an extended period of years. Nevertheless, it is clear that a very major reorientation is called for.

It is recommended that the Canada Department of Agriculture set as an immediate goal the allocation of 10 per cent of its research budget to supporting improvements in farm machinery, with this goal to be reached by 1980. By 1985 the allocation should be raised to 15 per cent.

Whether this goal can best be reached by simply expanding the total amount of support for research or by cutting back some existing research programs will be for the government to decide. However, the lack of rationale in some aspects of Canada's present agricultural research suggests that a major reassessment should be made of the whole program with a much more conscious attempt to relate costs to potential benefits.

In expanding its research program the Department of Agriculture will need to give careful consideration on how best to obtain a broad, long-range, balanced development of research on farm machinery. In the early years of the program, particular attention will need to be given to encouraging an expansion in the supply of graduate students by offering adequate scholarships or research assistantships. Special emphasis should be placed on an expansion of basic knowledge about farm machines, and specific provision should be made for research involving a number of different disciplines. In the immediate future, too, there may be a particular need for providing capital funds so that the universities involved can build and equip

adequate research laboratories. The Department of Agriculture should expand its own program of research on farm machinery very substantially as well. Rather than attempt to outline a detailed program of action, it is recommended that the Department set up an advisory committee with personnel drawn from the government, universities, and industry, and representing a number of different disciplines, to help it plan its expansion program. Implementation of the program recommended here could easily make Canada one of the leading countries in the world for the development of new farm machinery technology.

Chapter 18

MANAGEMENT IN THE FARM MACHINERY INDUSTRY

If generalizations are dangerous, they are doubly so in relation to management in the farm machinery industry. The wide divergence between companies–in size, number of products, and distribution methods–clearly makes an analysis of the management function in different companies a description of widely differing operations. The management operations of the giants of the industry (Massey-Ferguson, Deere, International Harvester, and Ford) are characterized by central control, with delegation of responsibility and the necessary authority to discharge it. Smaller companies are often run by one or two men who can be in the office, on the shop floor, or visiting dealers personally. The dichotomy between the different sizes of companies is striking. The large companies–including Case, the White Motor group, and Allis-Chalmers–contrast strongly in management roles and performance with the smaller firms such as Versatile Manufacturing Co., Killbery Industries Ltd., Dion Frères Inc., and McCoy-Renn Manufacturing. Each size level seems to carry a certain management type, suited to its needs.

Management performance in the Canadian farm machinery industry is important, both to the farmer and the country. The ability of any industry to compete–to develop new products that offer significant improvements over competition (whether foreign or domestic), to provide employment, and develop the profits necessary for continuing corporate existence–depends, in large measure, on the quality and effectiveness of its management. Management approaches used in this industry in Canada are substantially dependent upon the market and economic environment in which the industry operates, and on the fact that North America is regarded, by all large companies at least, as a single market. Canada, accessible on a free-trade basis to all North American farm machinery manufacturers, is looked on and managed as part of the continental market by top management. As such, the management of the Canadian subsidiary may not be required, or have the opportunity, to perform all the functions assigned to management. In the case of those companies not manufacturing in Canada, the only activities performed by Canadian management are distribution and sales; in the case of those making machines in Canada, more of the total concept of management in a manufacturing-marketing organization is evident.

For all companies manufacturing and selling farm machines, six problem areas exist. They impose strains on management skills, place a distorted emphasis on certain aspects of management at the expense of others, influence the priorities to which management resources are allocated, affect industry cost structures, and must inevitably have some bearing on the recruiting, training, and promotion of management. These problem areas are:

(1) Product Mix The tremendous diversity of products produced and sold in the industry is a major factor affecting its management. The Commission has estimated that it can identify no less than 100 different basic machines sold by the major full-line company. Many of these are produced in a large number of models which are basically different, in that one size with its component parts cannot be substituted for another. Nearly all have many options that can be added to make the end-products diverge further. The only common denominator for all the machines sold by the farm machinery company is that they are used by the farmer. This is increasingly a customizing industry, where the individual purchase can be tailored to the individual user's requirements.

The problem diminishes in complexity as the size of the company decreases, of course. It is mainly a problem of the large company; and the larger the company, the greater the problem appears to be.

Two results of the very large product-mix are production control problems, including higher inventories, and quality control problems.

The then President of C.C.I.L., Mr. John B. Brown, when he appeared before the Commission,[1] explained the problem of predicting needed production volumes far in advance of time of sale. Both for finished machines ordered from European suppliers and for products manufactured in their own Winnipeg plant, they were locked into a schedule for the subsequent calendar year in March of the preceding year, i.e. in March 1969, they had to predict what they would sell between April and November of 1970–14 to 21 months later. While minor modifications were possible, particularly for the whole machines imported from Europe (because their requirements were such a small proportion of the total production of Deutz or Claas), their own factory in Winnipeg was largely programmed some 15 to 18 months in advance of the point of sale. In no case was the period less than 12 months. Other companies, such as Cockshutt, have confirmed the same rigid prediction of sales volumes for production scheduling far in advance of time of sale.

(2) Unpredictability of Demand Farm machinery is characterized by very great fluctuations in year-to-year demand for the same product. While all industries face this sort of problem, the farm machinery industry suffers from both unpredictability and seasonality to an extreme degree. The farmer generally has a good deal of discretion regarding the timing of a major machinery purchase. He is,

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[1] Royal Commission on Farm Machinery, Transcript of Evidence, *Hearings*, Vol. No. 34, December 13, 1967, p. 3760.

therefore, strongly influenced by his own cash and anticipated income position. As noted elsewhere in this Report, he tends to purchase a new tractor, on the basis of need, in the spring to put his crop in the ground. He delays his purchase of harvesting equipment until just before the crop is ready for harvest. If the crop is heavy, and the crop marketing prospects are good, he will buy the combine; if either or both are poor, he will make do until the following year.

A senior representative of Massey-Ferguson, Mr. J. Staiger, President of Massey-Ferguson Inc., emphasized the problem facing the industry at the public hearings, "A drought in western Canada shuts off farm machinery 'bang' like that, and you may end up with all next year's supply of certain kinds of equipment sitting there waiting for the farmer who won't buy it. This is what we mean when we say that we have to make long term commitments but our customers just don't have to."[2]

(3) Seasonality of Demand—For most farm machines, the demand is highly seasonal. As noted above, part of this is related to the demand unpredictability, but much relates to the fact that farming is a seasonal industry.

(4) Service and Repair Facilities—The timing of farming operations is often very critical, and a farmer whose equipment breaks down during a busy season may incur a serious loss of income if it cannot be repaired quickly. For this reason the farm machinery companies have had to organize facilities for supplying repair parts quickly in time of emergency, and for providing service outlets where the machinery can be repaired. As machines have become more complex and sophisticated, the problem of providing adequate service and repair parts has become more difficult, as described elsewhere in this Report. It is the critical importance of this question that helps explain the industry's shift to the franchised-dealer type of organization at the end of the Second World War, and the continuing changes that have been occurring in the number and size of dealers and in the companies' branch-house organization. The provision of a warranty on major machines, and the problems of effectively supervising it, have added to management problems. Indeed, the entire dealer organization received a great deal of supervision, with regular calls from blockmen or district managers to record inventory, assist with sales, and adjust warranty problems.

(5) Technological Obsolescence—New developments in agriculture are making accepted ways of accomplishing tasks obsolete and the pace of technical change may well be accelerating. The disker made the plow almost obsolete in the Prairies, and with remarkable rapidity. Large tractors displaced smaller machines, and the first company to offer a significantly larger tractor found a real marketing advantage, for a season or two at least, in Western Canada and the United States. Corn heads on combines have at least partially displaced corn harvesters.

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[2] *Ibid.*, Vol. No 37, January 9, 1968, pp. 4099-4100.

(6) Conservatism of the Farmer–The farmer accepts change slowly and somewhat reluctantly. While he does not refuse to adopt innovations, he will accept modest departures from his present system more readily than radical changes.

The farmer also prefers step-by-step change, simply because of the cost of capital which he would have to write off for a major replacement of all his machinery. Then, the farmer who has accepted radical innovations has sometimes been hurt by equipment that was not fully functional.

To an important degree, these various factors interact and further aggravate the management problem. New machines introduced as a result of research and development have changed the optimum size of farms, and over time have produced a strong trend towards fewer and larger farms. This not only reduces the volume available to the industry, in terms of the number of machines of any one type that can be sold, but it also may produce changes in the size and structure of the dealership system needed to service the changing farm market.

How do these factors affect management in the farm machinery industry? It can be shown that each should place a certain pressure or constraint on management, which probably encourages the recruiting of managers with certain types of personality, training, and experience. It will also reward the display of certain attributes associated with the industry.

The complexity of the product mix of the major companies is primarily the result of the diverse requirements of different types of farming in different geographical areas, and of the conventional wisdom of the industry that the heavy cost of the distribution system must be spread across as wide a product base as possible. The ideal farm, as far as the industry is concerned, is one where all machinery shows the same colour scheme–Deere's green (carried over to the green blood of its executives!), Massey-Ferguson's red and grey, International Harvester's red and white, and Cockshutt's red and cream. They must be able to provide all the farmer's needs, no matter the size or crop type. The growing number of models and different sizes may also reflect the industry's preference for non-price, as compared to price, competition.

The result has been a proliferation of models, accompanied by design and manufacturing problems created by low-volume production of designs, many of which are only slightly different from others in the same company, and which must sometimes be rushed into production to plug a marketing hole in the company's product line-up created by a rival entry. It shortens production runs to the point that one company in the United States, reporting privately to the Commission, produced 816 tractors in January 1968, 815 of which differed in specifications!

In this context, management would be selected and rewarded for its ability to develop a new product, to respond quickly to a competitor's challenge in new products, or to improvise and make do with inadequate production facilities.

If demand in any year is as unpredictable as described to the Commission, it would be hard for top management or shareholders to find fault with a market planner who did not anticipate it correctly. Since it would at times be natural to expect to have to carry over large stocks of machines from one year to the next, it would not be considered necessary, or even possible, to develop tight inventory controls. The cost of a "stock-out" in terms of a lost sale, and the loss of a future contact with a farmer who has bought a rival machine, would indicate that a high inventory was justified.

Then, too, the distribution budget of a company is developed, not on the basis of its real sales but of its anticipated sales. Branch offices, blockmen, and advertising are all planned as tools to achieve a certain sales volume. If demand falls short of prediction, the room for manoeuvre to reduce expenses is small. The closing of branch offices would exacerbate the situation; if good branch personnel were laid off, they would not be available when business eventually picked up again.

The unpredictability of demand, then, works against quick response by a company to a market decline. The company's distribution costs go on, and its products are already manufactured. Its reaction is likely to be to spend more to promote the highest level of sales possible under poorer market circumstances. This is "mini-max" strategy: if profits cannot be maximized, losses must be minimized.

The highly seasonal nature of demand reinforces its unpredictability. In Canada, 85 per cent of combines are sold in August, September, and October; 61 per cent of tractors are sold in the spring (April to June) and in October (see Table 6.1).

As a result, what the demand is going to be in any season is not known until the short selling season is over. One can compare sales of tractors in April, for example, with those of the previous year. By the time the data are available in May, however, the tractor plant in North America has been locked into a production schedule which is fixed, or largely so, at existing volumes until December. Commitments will have been made to suppliers for raw materials and parts to the extent that it will be necessary to "build out" the relatively rigid production schedule. The schedule may be stretched out over a longer period and options changed, at increased costs, but it will be difficult to change the total volume of production planned without incurring heavy obsolescence charges, in-house and at suppliers.

In May, too, the problem exists as to how to read the April sales. Was it the late spring that caused the decline; will June sales recover? Was it a regional slump only, affecting certain models in the schedule, or does the slump represent or predict an across-the-board lowering of demand? Can additional marketing action be taken to counter the effect of the slump? Can incentive programs or additional advertising make the effect less on the company than on its rivals, increasing its penetration as a percentage of the whole market?

The fifth factor affecting management is the imminent threat of technological obsolescence. For example, is the hay-baler to become obsolete with the hay-cuber or the hay-waferer? If so, how much additional development money should be spent on the hay-baler? Can much higher performance be secured from it? Or will an extensive redesign of the appearance of the machine a "facelift" - be enough to increase sales? These are the sorts of questions which the farm machinery executive must constantly consider. Where should the always limited development resources of men and money be allocated? Where will the next breakthrough come?

The conservatism of the farmer with relation to radical new ideas will join with the existing manufacturing technology and investment to limit major new innovations. In the case of the hay-waferer, or a similar machine, it is likely that it will not be copied by a rival until it is a proven technological and market success. The risks are too great.

Emphasis in new product design will be placed on the feed-back of information from the farmer and the farm community. The disker originated on the Prairies, not from a company's development program, but from farmers' ideas developed into machines by local blacksmith shops. It was first marketed commercially not by a major machinery company, but by the newly established C.C.I.L. The Commission was told that Massey-Ferguson's pressure control was developed in the late sixties from a dormant idea which had first been used by the old Ferguson company in adapting their light tractors to move heavy aircraft engines around factories in Britain during the Second World War.

Although patent suits were prominent in the industry's early history, the industry now readily licenses its patents to its competitors, often with only a one-year lag. Undoubtedly this practice reflects one method of reducing uncertainty in an industry which faces uncertainty from a number of sources.

The management profile which emerges from this recital of the problems to be solved, and opportunities to be exploited, in the farm machinery industry emphasizes the sales executive. The availability of men who know how to reach the farmer, who have a sixth sense of what is going to happen, may well mean the difference between the success and failure of an organization.

The industry is dominated by the problems of market unpredictability and seasonality, while burdened with a production system which has to turn out products on a regular basis. The sales manager who is able to flog the merchandise may represent the difference between his company's losing its market position and beating out another rival company lacking the same sales resources.

Where will such an executive come from? It would appear that many of the senior executives in the farm machinery industry have come up through the selling side of their companies. Particularly in Canada, the production- or finance-oriented top executive is rare.

One way in which market unpredictability and seasonality may be countered is to consider a market larger than North America. Thus the Big Three of the industry produce and sell throughout the world. All wheat lands do not suffer from drought simultaneously; markets for all kinds of farm produce do not decline together; the dead winter-sales period of the northern hemisphere is offset by the concurrent summer in the southern hemisphere. Thus tractor manufacturers, manufacturing for a world market, have significant advantages over those who are limited to the North American market. Senior management in the industry tends therefore to be very mobile, both physically and in its thinking. There is always some area about which to be optimistic.

The uncertainty and fluctuation in the industry and the slow long-term growth of demand make it difficult to justify the use of new production facilities. New facilities are generally much more productive than those they replace, but how is the new production to be sold? Is there certainty that it can be sold? Given that the market for farm machinery is small and highly diversified, there may appear to be less justification for the automated technologies of modern metal-working than in other industries.

Fundamentally, much farm machinery is produced on a job-shop basis. Many factories batch their production operations to achieve lowest costs. The lowest-unit-cost machine is produced first and the highest-cost last, in order to reduce the inventory-holding costs of finished goods. If the year's supply of manure spreaders is produced, however, in November and December of the previous year, the company is "locked in" to a volume which must be sold to avoid accepting an unbudgeted loss. In the same way, it cannot sell more of a product than has been made, no matter how much greater the demand.

Another method used by the farm machinery companies to reduce their risk has been the development of interest-free floor-planning in the hands of the dealer. The dealer is encouraged in this way to buy, and stock on his premises, finished farm machines. Although he owns them and is obliged eventually to pay for them if they are not sold, his first payment may not be due for from 12 to 23 months. And where adverse circumstances cause sales to fall sharply, the company may make special arrangements to extend further credit, so the dealer's inventory can be carried for a further period. To some degree, however, the risk attached to holding large inventories has been passed on to the dealer.

As was shown elsewhere in the Report, major companies are reluctant to make price cuts, because they can rarely expect the increase in sales volume necessary to make such a price cut profitable. At times, an alternative to price cuts may be increased expenditure on promotional devices. Since this does not permanently depress price levels, it is more acceptable to the companies, and may result in less loss of profits in a difficult period than either the maintenance of higher prices or outright price reductions.

The farm machinery industry will, therefore, tend to attract managers oriented towards sales activities. Its production operations must be organized so that they are as flexible as possible. Production costs will be less critical than production flexibility. Designs will be often secured from outside sources rather than from within the company (although this is changing for some of the larger companies), and copying competitors' designs appears to be the recognized way of expending product lines to meet new developments.[3] Efforts spent on selling machines already produced will be more profitable than the almost impossible task of trying to match production to a largely unpredictable market.

Farm machinery industry managers will, therefore, tend to be conservative, cautious in their forecasts, and careful in their investments. The high average age of machine tools in the industry[4] indicates the reluctance of managers to invest in high-risk situations. While all metal-working industries reported only 23 per cent of their machine tools to be older than 20 years, the farm machinery industry reported 41 per cent of its equipment in this category. As well, it may indicate the fact that machine tools have become capable of producing higher volumes than the farm machinery industry can absorb.

Within the general pattern of management, variety does exist. There are very large companies like Deere & Company and Massey-Ferguson Limited, along with relatively small specialty producers—ranging, in Canada, from Golden Arrow Manufacturing Limited of Calgary, Alberta (largely producing sprayers) to the new Thomas Equipment Ltd. of Centreville, New Brunswick, concentrating on potato-harvesting equipment capable of discriminating between potatoes and stones.

Massey-Ferguson's management problems over the years have been recorded by Neufeld in *A Global Corporation.*[5] While the extensive difficulties encountered in its growth to a world corporation do not need to be repeated here, its management difficulties, dead ends, and triumphs make fascinating reading. It is hard not to conclude that part of its problems after the Second World War stemmed from its being a farm machinery company. Its growth to world stature and solid viability required extensive management inputs from outside the farm machinery industry. It is at least possible that it would not be in its present strong position if it had not, more or less accidentally, expanded into overseas markets under the pressure of tariffs relating to foreign markets into which it had penetrated. One senses that a number of key decisions were made—the merger with Ferguson, and the acquisition of Perkins' engine and Standard Motors' tractor facilities—without a clear appreciation at the time of how important they were to be in the longer-run growth of the company.

These large companies vary in management resources and sophistication from one to another, and within their own organizations. Deere & Company has

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[3] White Motor's and Deere's four-wheel-drive tractors with centre-articulated steering appear to be functionally identical to the Versatile concept.

[4] D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table 7.8.

[5] E. P. Neufeld, *A Global Corporation,* University of Toronto Press, 1969.

consistently had a high earnings record for the industry. As shown elsewhere, it appears to be the price leader and to be able to price somewhat above the levels of its rivals for comparable models. Its consistent ability to market its products at higher prices indicates a management which has been successful in meeting the problems of the industry. Its continued record of highest pre-tax earnings among the major farm machinery companies also emphasizes this fact.

Although smaller in size, J. I. Case has been able to adjust successfully to the changes in the industry. After nearly going under in the early sixties, new management proceeded to pull it out of its difficulties, concentrating on product improvement and dealer development.

The most spectacular growth of all companies in the farm machinery industry in North America has probably been that of Versatile Manufacturing Ltd. This company was started as a two-man organization, concentrating on low overheads and low distribution costs, specializing in a narrow range of machines with a limited series of options. Its growth to a significant factor in the industry—to the point that it became the leading producer of swathers—indicates that the industry as a whole is still responsive to new approaches.

The many smaller companies represent, in many cases, one- or two-man shops. The farmer-blacksmith-inventor designs a better machine, peculiarly adapted to a certain situation. An example of invention to meet a local requirement is the Morris rod weeder. Machines are built and sold; modifications to designs are made; but most of the management decisions are informally made by a single man only. As long as specialty machines are built, for particular crops or local conditions, the small companies will flourish, because they have flexibility and low overheads which are not available to the giants of the industry.

The way in which the farm machinery industry is managed is of interest to the farmer. At the one end of the size spectrum, he sees a small group of industrial giants; at the other, local organizations making special-purpose equipment. To the extent that large firms concentrate their management talents on selling, deeming it relatively more important than production and cost control, the farmer may have to pay relatively more for his farm machine, or receive poorer service, than he would in the case of another industry that was able to balance its efforts.

At times in the past, the farm machinery industry has marketed machines that were not fully tested for the situations in which they were used; its quality control functions have proved in certain cases to be less than adequate. Some of its production centres are obsolete, too small, or both; and its production control system is still unable to cope with the fluctuations of a volatile and uncertain market. Having to concentrate much of its managerial resources on selling may prevent it from improving in these other areas. The heavy emphasis on selling diverts management resources from other areas where, from the viewpoint of the farmer, they might be better employed in improving the design and quality of the machine, and in reducing its cost of manufacture.

Chapter 19

THE FUTURE MARKETS FOR FARM MACHINERY

This chapter examines the market demand for farm machinery. In analyzing this market it is useful to divide the world into three major areas—Western Europe, North America, and the rest of the world. The latter area can, in turn, be divided into the Communist-bloc countries, the developing countries, and a few other advanced countries such as Australia, New Zealand, and South Africa. Because these latter markets are relatively small and very distant from Canada they have been neglected here. The market for farm machinery in the Communist-bloc countries, especially Russia and Eastern Europe, is important, and these countries are also potential suppliers of farm machinery to the West. Up to the present, however, there has been relatively little trade in farm machinery between these countries and the western world. Since there is no accurate way to assess the future potential of this trade, these have been neglected in this chapter also. Accordingly, the topic will be treated under three major headings—Western Europe, North America, and the Developing Countries.

Before proceeding to an analysis of each of these markets it will be useful to consider briefly some of the characteristics of the demand for farm machinery and the changes that have occurred in this demand over the past few decades. When the principal tools used by a farmer were a hoe, spade, sickle, and flail, his requirements for farm machinery were comparatively simple. However, with the introduction of domesticated animals (the horse, the mule, and the ox), more sophisticated implements began to appear—first the plow and reaper, and later the binder, the thresher and a range of seeding, cultivating and harvesting equipment. With the development of the tractor, animal power gradually disappeared, and with a continued flow of new inventions, farming became more and more fully mechanized.

In North America the tractor first came into extensive use in the twenties and thirties, but it was not until the war and early postwar years that farming became almost completely a tractor operation. The result of this shift from animal power to machine power has been a significant increase in the total farm demand for machinery. This structural change is evident in Figure 19.1 where a strong upward

FIGURE 19.1-FACTORS AFFECTING MACHINERY USE, U.S. AGRICULTURE, 1920-69

trend in the input of mechanical power and machinery can be seen between 1929 and 1952, a period that pretty well coincides with the demise of the horse and mule as a feature of American agriculture. Since 1952, the input of mechanical power and machinery has paralleled fairly closely an index of crop production. This reflects the fact that farm machinery is still predominantly oriented to use in the production of field crops rather than livestock or livestock products.

The upward trend in the use of machinery also has its counterpart in the decline in the use of farm labour. In the United States this decline has taken place at a rapid and remarkably steady rate throughout the period since 1944. By 1969 the labour input into U.S. agriculture was only about one-third of its amount in 1944. This reflects both a decline in the farm labour force and reduction in hours worked per week. As is described elsewhere in this Report (see Chapter 23), labour has been both pulled and pushed off the farm. It has been pulled off by the attractions of wages and employment opportunities in non-farm activities; it has been pushed off by the continuous flow of technological change in farm machinery which has steadily reduced labour requirements in agriculture despite continued growth in farm output.

Developments in Canadian agriculture over the past few decades have been broadly similar to those in the United States. Thus, as is evident from Figure 19.2, the same upward shift in the use of farm machinery relative to the volume of field crop production has occurred in the postwar period. This corresponds pretty well to the "tractorization" of Canadian farms. Its counterpart was the precipitous decline in the number of horses on farms from about 1943 onwards. Also evident is the rapid decline in the farm labour force.

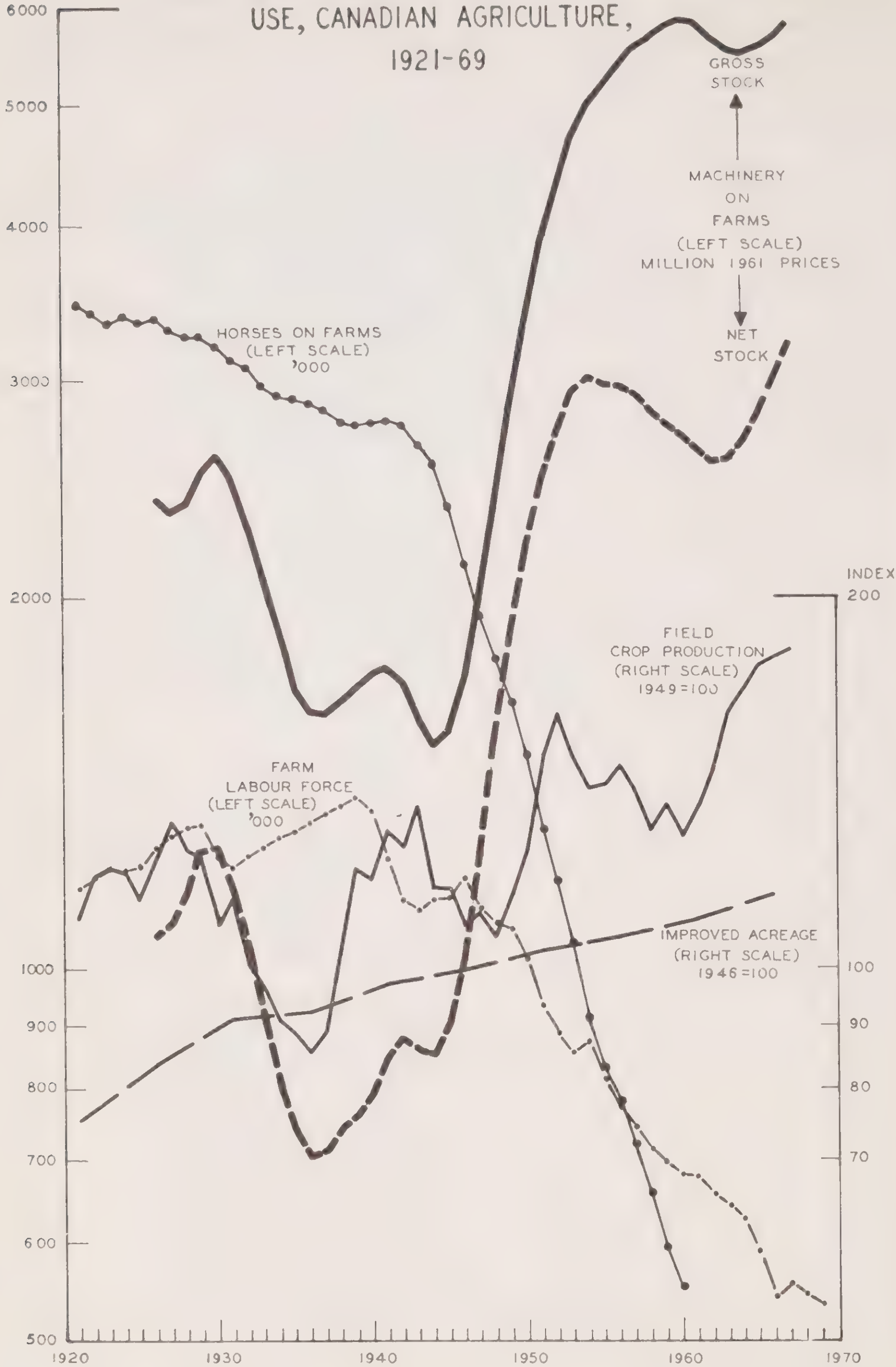
A significant part of the increase in the stock of machinery and equipment on farms, shown in Figure 19.2, represents trucks and a share of passenger cars considered to be used for farm purposes, rather than farm machinery in the conventional sense. Thus, as the data in Table 19.1 show, by 1966 about $11.60 of

TABLE 19.1–GROSS STOCK OF MACHINERY AND EQUIPMENT ON CANADIAN FARMS, PER FARM AND PER IMPROVED ACRE, SELECTED YEARS, 1926-66 (1961 PRICES)

	Including Trucks and Share of Passenger Cars		Excluding Trucks and Passenger Cars
	Per Farm	Per Improved Acre	Per Improved Acre
1926		$30.60	$27.70
1931	$ 3,440	29.20	24.10
1941	2,410	19.20	15.30
1951	6,130	39.50	32.30
1956	9,350	53.50	41.30
1961	12,100	56.30	44.80
1966	13,150	52.40	40.80

Source: Commission estimates.

FIGURE 19.2–FACTORS AFFECTING MACHINERY USE, CANADIAN AGRICULTURE, 1921–69



the total investment per improved acre on Canadian farms consisted of farm trucks and the farm-purpose share of passenger cars. However, when cars and trucks are excluded, there is still a significant upward shift in investment in machinery and equipment per improved acre. The gross stock in use on this basis increased from \$27.70 per acre in 1926 to \$44.80 in 1961 and \$40.80 in 1966.

Undoubtedly, part of this increased stock of machinery and equipment in use on Canadian farms simply represents the effects of the replacement of the horse by the tractor. Another factor has been the mechanization of an increased range of farming activities; haying, for example, is now almost completely mechanized. This mechanization has been induced by the scarcity and increasing cost of farm labour. It has also resulted from the effects of technological progress in farm machinery, which has had a strong labour-saving effect. An additional source of this increased demand for, and use of, farm machinery has been the desire on the part of the farmer to eliminate much of the back-breaking labour formerly associated with farm activities and the related demand for increased comfort. Hence the demand for grain augers to move grain, front-end loaders for lifting and loading, and tractor cabs and improved seats for greater comfort.

Any explanation of the increased demand for farm machinery that has occurred in various countries must take some account of all these considerations. The emphasis above has been on changes in the stock of machinery in use on farms. Annual purchases of machinery produce the net and gross changes in this stock. Because machinery is durable and older machinery can often be used for several more years, annual expenditures on machinery may fluctuate markedly from year to year, depending on the farmer's net income position, his income prospects in future years, the availability of credit and the price of machinery. The effects of all these factors will be evident in the discussion of the three major areas which follows.

The Market for Farm Machinery in Western Europe

At the end of the Second World War farm mechanization in Western Europe was less advanced than in North America, but since that time it has advanced rapidly.[1] This can be seen from the data in Table 19.2 which show the worldwide distribution of farm tractors for a period of several years after the war and in 1966. Thus by 1966 the number of tractors in use in Western Europe had increased almost threefold over the level of 1952-56, and was beginning to approach the number on North American farms. In this same period the number on American farms increased by only 13 per cent. Large percentage increases were also shown during this period in Asia, Latin America, and in Eastern Europe and the U.S.S.R.

Because of its intensive agriculture, Western Europe has now achieved a high level of tractor use per unit of land. However, relative to the farm labour force, the

[1]For a full discussion of this market for farm machinery, see H. G. Scott and D. J. Smyth, *Demand for Farm Machinery—Western Europe*, Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970).

use of tractors is still far below the level prevailing in North America and in Australia and New Zealand (see Table 19.3). In Eastern Europe and the U.S.S.R. the use of tractors in relation to both land and labour is well below levels prevailing in either Western Europe or North America.

TABLE 19.2 – TRACTORS ON FARMS, BY MAJOR AREAS OF THE WORLD, 1952-56 AND 1966

	Average 1952-56	1966	Increase 1952-56 to 1966
	(Thousands)		(Per cent)
Western Europe	1,580	4,536	187
Eastern Europe and U.S.S.R.	957	2,368	147
North America	4,793	5,425	13
Latin America	199	512	157
Asia	85	251	195
Africa	58	103	77
Oceania	249	406	63
World Total	8,006	13,812	73

Note: Data for Asia exclude China and Israel. Data for Africa exclude South Africa. The world total includes Israel and South Africa, but excludes China.

Source: H. G. Scott and D. J. Smyth, *Demand for Farm Machinery – Western Europe,* Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Table 2.1.

TABLE 19.3 – TRACTOR USE PER UNIT OF LAND (1954 AND 1966) AND LABOUR (1954 AND 1964), BY REGION

	Tractors per 1,000 Hectares of Arable Land		Tractors per 100 Farm Workers	
	1954	1966	1954	1964
Western Europe	16	44	5	17
Eastern Europe and U.S.S.R.	3	8	2	7
North America	21	24	67	90
Latin America	2	5	n.a.	n.a.
Australia and New Zealand	7	10	41	66

Source: H. G. Scott and D. J. Smyth, *Demand for Farm Machinery – Western Europe*, Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Tables 2.2 and 2.3.

Data on the world use of combine harvesters is less complete than for tractors, but the data available indicate that Western Europe has a smaller share of the world total of combines than of tractors, and has less in absolute numbers than North America or Eastern Europe and the U.S.S.R. However, measured in terms of cereal production and the amount of land devoted to cereals, the use of combines in Western Europe is only moderately lower than in North America and is much higher than in the U.S.S.R. This is evident from the data given in Table 19.4. The

lesser use of combines in Western Europe may reflect in part the smaller farms which are less suited to the use of combine harvesters. The increased use of combines over the postwar period in Western Europe has been particularly strong, thus making the region an important source of demand for this machine. By 1954, North America had more or less reached a replacement level for this machine although an upgrading in the size and quality of combines in use has been occurring there since that date.

TABLE 19.4–TOTAL COMBINE HARVESTERS IN USE, BY REGION, RELATIVE TO CEREAL CULTIVATION AND PRODUCTION, 1954 AND 1964

	Combines in Use (Thousands)		Combines in Use in 1964	
	1954	1964	Per 1,000 Hectares of Cereal Acreage	Per 1,000 Tons of Output
Western Europe	90	420	11	4.5
Eastern Europe and U.S.S.R.	350	600	4[1]	3[1]
North America	1,100	1,160	14.5	5.5
Oceania		70	8	6

[1]Data are for U.S.S.R. only.

Source: H. G. Scott and D. J. Smyth, *Demand for Farm Machinery–Western Europe*, Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Tables 2.4 and 2.6.

Absorption is defined as the value of production, plus imports and less exports. On this basis, the absorption of agricultural machinery in Western Europe had reached about 2.6 billion U.S. dollars by 1965, about $1 billion less than its level in North America. In relation to agricultural employment, absorption in Western Europe is still very much lower than it is in North America. This is evident from the following data:

Absorption of Agricultural Machinery per Farm Worker, 1964-65

(U.S. dollars)

	Tractors	Other Machinery	Total
Western Europe	49	66	115
North America	270	380	650

Thus in 1964-65 the annual purchase of farm machinery in Western Europe amounted to only about $115 per farm worker compared with $650 in North America. Data are at factory prices. On the other hand, in relation to total arable land, annual absorption of farm machinery is higher in Western Europe, amounting in 1964-65 to about $27 per hectare compared with just $16 per hectare in North America.

Within Western Europe, there is a decided contrast in respect to the extent of farm mechanization between the industrialized countries of Northwestern Europe, with their comparatively high per capita incomes, and the poorer and less industrialized countries of Southwestern Europe. Southwestern Europe is taken here as Greece, Italy, Portugal, and Spain, although Italy has some of the characteristics of both regions. Northwestern Europe has little more than half the total arable land and little less than half the agricultural labour force of the two areas; yet it dominates the use of, and demand for, farm machinery. This is clearly evident from the data in Table 19.5.

TABLE 19.5–FARM MACHINERY USED (1966) AND ABSORBED (1965), WESTERN EUROPE, BY REGION AND MAJOR COUNTRY

	Used (1966)		Absorbed (1965)	
	Tractors	Combines	Tractors	Other Machinery
	(Thousands)		(Millions of U.S. dollars)	
Western Europe	4,453	498	1,100	1,500
Northwestern Europe	3,760	460	900	1,300
Southwestern Europe	693	38	200	200
France	1,051	109	250	313
West Germany	1,215	142	344	492
Britain	455	65	134	139
Italy	461	14	126	147

Source: From H. G. Scott and D. J. Smyth, *Demand for Farm Machinery–Western Europe*, Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Table 2.9.

Other measures as well indicate the much more advanced state of mechanization in Northwestern Europe. Thus the tractor horsepower in use per person employed (1966) at 10.6 is almost five times as high as the level of 2.2 for Southwestern Europe. Again tractor horsepower per 100 hectares of arable land at 226 in Northwestern Europe is about four times as high as the 57 HP for Southwestern Europe. Similarly, Northwestern Europe has 19 combines per 1,000 hectares of cereal acreage compared with just 2 in Southwestern Europe.

There are also significant variations in the extent to which tractors and combines are used among the major countries. Thus, as the following data show, Britain uses more tractor horsepower per employee than either West Germany or France; yet West Germany uses more tractor horsepower and more combines in relation to her land area.[2]

[2] *Ibid.*, Tables 2.10 and A.9.

	Tractor Horsepower		
	Per Farm Worker	Per 100 Hectares of Arable Land	Combines in Use per 1,000 Hectares Of Cereal Acreage
Northwestern Europe	10.6	226	18.5
Southwestern Europe	2.2	57	2.3
France	9.5	161	12.0
Germany, Federal Republic	9.7	340	29.0
Britain	21.2	250	17.0
Italy	3.6	110	2.5

Since 1950 Western Europe has undergone rapid mechanization. However, the rate of growth in machine utilization has varied widely among different countries. In Britain and Sweden, mechanization was already well advanced by 1950, and subsequent progress as a consequence has been slow. Some countries like West Germany, Belgium and Denmark underwent rapid mechanization in the early 1950s and slowed down later. Others like Spain started with very little machinery but in the past few years have experienced rapid growth.

At the beginning of the period, Southwestern Europe was virtually unmechanized. By 1966 it had attained the level of Northwestern Europe in the early 1950s. However, over the period, most of the growth in both tractors and combines has been in Northwestern Europe. Because it started from such a low use level, even rapid growth in Southwestern Europe did not bulk large in absolute terms. This is evident from the data in Table 19.6.

TABLE 19.6–MECHANIZATION OF AGRICULTURE IN EUROPE, 1950-66

	1950	1956	1960	1966
	(Millions of horsepower)			
Tractor Horsepower in Use				
Western Europe	22.1	52.5	75.8	139.5
Northwestern Europe	19.8	46.0	66.0	114.3
Southwestern Europe	2.3	6.5	9.3	25.1
	(Thousands)			
Combine Harvesters in Use				
Western Europe	29	110	239	498
Northwestern Europe	28	107	228	460
Southwestern Europe	1	4	11	38

Source: H. G. Scott and D.J. Smyth, *Demand for Farm Machinery–Western Europe,* Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Tables 2.11 and 2.12.

Related to the demand for farm machinery in Western Europe have been the changes in the pattern of use of other resources–in particular, land, fertilizer, labour, and animal power. Consider each of these in turn. Over the period examined there has been very little change in the total stock of arable land and in the amount

used for cereal cultivation. The same is true for both major areas in respect to arable land. Land under cereal cultivation declined by about two million hectares in southern countries and increased by about the same amount in the Northwest. However, there was a major increase in the use of fertilizer over this period–from six million tons in 1954-55 to 13 million tons in 1964-65–mainly in the Northwest. It consumed 83 per cent of the total in the latter year.

Employment in agriculture has declined rapidly in both areas–more rapidly between 1950 and 1960 in the Northwest, but swifter in the South since 1960. Over the period, the decline in both areas has been almost the same. Six countries account for 80 per cent of Western Europe's agricultural labour force. There are also large farm labour groups in Yugoslavia and Turkey. Among these the level of tractorization varies widely. Thus the number of tractors per 100 farm workers varied as follows in 1966: France 31.0, West Germany 42.0, Greece 2.5, Italy 9.9, Portugal 1.8, Spain 4.2, Turkey 0.5, and Yugoslavia 1.0.

The replacement of animal power was evidently an important source of demand for tractor power during the fifties. If one horse is taken as the equivalent of seven horsepower, the comparison provided in Table 19.7 can be made. The data given there indicate that the replacement of animal horsepower has accounted for more than half of the increased use of tractors in Western Europe. For Southern Europe the proportion has been even higher. Animal power replacement has been particularly important in France, West Germany, and Spain. As of 1960 there was still the equivalent of 65 million horsepower of animal power in use in agriculture in Western Europe, about 30 million in the Northwest, and 35 million in the South. However, a substantial part of this may well have been replaced during the past decade.

TABLE 19.7–NET CHANGE IN TRACTOR AND ANIMAL HORSEPOWER ON FARMS, EUROPE, SELECTED YEARS, 1950-65

(Millions of horsepower)

Net Change 1950 to 1960	Tractor	Animal	Total
Western Europe	53.7	−27.4	26.3
Northwestern Europe	46.2	−22.1	24.1
Southwestern Europe	7.5	− 5.3	2.2
Net Change 1960 to 1965			
France	11.8	− 4.8	7.0
West Germany	10.7	− 3.9	6.8
Italy	7.5	− 1.7	5.8
Spain	4.0	− 3.4	n.a.[1]

[1] Since the Spanish animals include some for non-agricultural uses, totals are not given.

Source: H. G. Scott and D. J. Smyth, *Demand for Farm Machinery–Western Europe,* Royal Commission on Farm Machinery, Study No. 9 (Ottawa: Queen's Printer, 1970), Tables 2.18 and 2.19.

The continued use of animal power and the comparatively low rate of tractorization per unit of labour in a number of European countries suggests that there is still a large potential market for farm machinery in this region.

The econometric analysis of the demand for tractors in Western Europe, carried out for the Commission, indicated that for 15 different countries there was a significant relation between the amount of tractor horsepower used per farm worker and the ratio of farm wage rates to farm tractor prices. Thus, as farm wage rates in a country increase in relation to tractor prices, there is an incentive to substitute tractor power for labour. This same analysis showed that the proportion of all farms over 10 hectares and 20 hectares in size also had a significant effect on the amount of tractor horsepower in use.[3] Many of the farms in Western Europe are so small and fragmented as to make the use of tractors difficult. Thus, if the provisions in the *Mansholt Plan,* calling for incentives for the amalgamation of many of these very small units, are carried out, it should have some further favourable effects on the demand for farm machinery. The relationship between the use of tractor horsepower per farm worker and the relative prices of tractors and labour was confirmed by a study of the growth of the use of tractors in Britain over the period from 1948-65.[4] Taken together, the two studies suggest an elasticity of substitution of about 1.5. In other words a 1 per cent increase in the tractor/labour-price ratio will lead to a 1.5 per cent increase in the amount of tractor horsepower used per worker. Thus the steady rise in non-farm incomes, which in turn helps pull up farm labour rates, provides a substantial incentive to substitute machinery for labour on European farms.

Some attempt was also made to assess the effects of changes in the type of farming on the amount of machinery used in relation to labour. Shifts from the production of crops to livestock products is associated with a decrease in the use of machinery relative to labour. On the other hand, a shift in production from traditional, extensive livestock production to factory-type methods, as are already used for broilers, involves an increase in the relative use of machinery. Since both of these shifts seem to be occurring, they will partially offset each other.

In sum, the rapid mechanization in Northern Europe which followed after the war and which has now shifted to Southern Europe can be expected to continue for some time to come, especially in countries such as Italy, Spain, and Greece, where the amount invested in tractors and other farm machinery per farm worker is still comparatively low, and where the replacement of animal power by tractor power is still not complete. Further progress in the amalgamation of farm units will also stimulate machinery demand. However, machinery use in Britain and some of the other more advanced countries of Northwestern Europe has now reached a high level and is becoming more a replacement than a growth market.

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[3] *Ibid.*

[4] A.J. Rayner and K. Cowling, "Demand for a Durable Input: An Analysis of the United Kingdom Market for Farm Tractors", *Review of Economics and Statistics,* 49:590-598, November 1967.

The Market for Farm Machinery in North America

The United States - The market for farm machinery in the United States is a rich and varied one. For 1967, total sales of farm machinery and parts at wholesale prices to dealers amounted to about $3,067 million. Some indication of the importance of different commodity groups for both the United States and Canada is given by the data in Table 19.8. In this table, imports into the United States are not broken down by commodity group. However, it is known that a significant part of these consisted of combines.

TABLE 19.8 -TOTAL SALES OF FARM MACHINERY IN NORTH AMERICA, 1967

(Values given in thousands of U.S. dollars[1] at wholesale value or price to dealers)

Machine Title[2]	Canada	United States
Planting, seeding, fertilizing equipment	21,836	183,312
Harrows, rollers, pulverizers	[3]	196,196
Plows and listers	19,299	117,386
Harvesting machinery	99,172	624,187
Haying machinery	26,802	158,684
Sprayers and dusters	3,716	61,266
Cultivators, weeders	31,231	102,387
Farm wagons and other transportation equipment	5,339	77,623
Tractors (excluding garden)	136,541	895,459
Farm elevators and blowers	[4]	44,592
Machines for preparing crops for market or for use	13,783	102,578
Silo unloaders	1,758	22,983
Parts[5]	57,349	172,938
Imports[6]	–	307,270
Total	416,826	3,066,861
Total–North America	3,483,687	

[1] Canadian dollars converted to U.S. dollars at rate of 92.5.

[2] Based on classifications from U.S. Current Industrial Reports (S.I.C. classification).

[3] Included with "cultivators and weeders".

[4] Farm elevators included with "machines for preparing crops for market or for use". Blowers included with harvesting machinery.

[5] U.S. figures include value of parts for all machines except tractors. Figure of $172,938 is for tractor parts. Canadian parts figure is for all machines, including tractors. Because some machine categories are not included in this table, e.g. farm dairy machinery and equipment, the figure for parts may be slightly overstated.

[6] Canadian imports included in Dominion Bureau of Statistics, *Farm Implement and Equipment Sales,* Cat. No. 63-203. U.S. imports taken from U.S. Bureau of the Census, *U.S. Imports General and Consumption,* Washington, 1968. U.S. imports exclude "farm wagons and other transportation equipment" but include mowers. U.S. imports of parts exclude parts for tractors and include parts for plows and listers, cultivators and weeders, and harvesting machinery only.

Source: D. Schwartzman, *Oligopoly in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 12 (Ottawa: Information Canada, 1970), Table E.1.

Measured in 1958 dollars the gross stock of farm machinery on farms in the United States amounted to $24.7 billion in 1965, more than three times the level of the late twenties. The growth in this stock by five-year intervals has been as follows (in billions of 1958 dollars):

1925	7.3	1950	16.8
1930	9.3	1955	22.7
1935	8.1	1960	24.7
1940	8.8	1965	24.7
1945	10.5		

Growth was rapid during the first decade after the war, but since then, has been much slower; between 1960 and 1965 the total stock remained stationary.

While the over-all demand for machinery by the American agricultural industry appears to be approaching a replacement level, at the individual farm level investment is still increasing. This reflects the fact that recent developments in technology–in particular, the larger-horsepower tractor–have favoured the growth of larger farming units. However, the adjustment to a larger farm size takes place slowly, since many existing farm operators are not willing to leave the industry. Thus the availability of additional land is a constraint on changes in the size structure of farms.

Other major variables affecting the demand for farm machinery are the relative prices of labour and machinery, farm-input prices relative to farm-product prices (a measure of the profitability of farming), and the capital or equity situation in the industry. Over the postwar period, except for an initial postwar price readjustment, farm labour prices have risen significantly more than farm machinery prices. Thus, between 1950 and 1960, farm wages increased by 49 per cent compared with 37 per cent for farm machinery, and between 1960 and 1968, wages rose 52 per cent compared with 29 per cent for farm machinery. Moreover, to some degree, the farm machinery price index overstates the relative price of machinery, since the index takes no account of the degree to which new machines provide cost-saving replacements for obsolete machines, and it fails to record many minor improvements. Further, the relevant comparison is between the operating costs of farm machinery and labour rates. Since the price of diesel fuel and lubricating oil has risen very much less than machinery, the use of the machinery price index overstates the true cost comparison to the farmer. Over the longer period since 1929, farm wage rates have risen just over five times, compared with the slightly more than threefold increase recorded by farm machinery prices. Thus the more rapid increase in wage rates over this period must have provided a substantial incentive to substitute capital for labour.

In a major study published in 1963, Heady and Tweeten estimated that "the elasticity of annual investment with respect to prices of machines or prices received approximately is unitary in the short run".[5] In other words, they estimated that a

[5] E. O. Heady and L. G. Tweeten, *Resource Demand and Structure of the Agricultural Industry* (Ames: Iowa State University Press, 1963).

1 per cent increase in farm machinery prices or a 1 per cent fall in prices received by farmers would cause a decline in demand for farm machinery by 1 per cent. They also estimated that the elasticity of demand for farm machinery with respect to the farm equity ratio was –.41. In effect, a 1 per cent increase in the farm-equity/farm-liabilities ratio would increase demand for farm machinery by .41 per cent, and a 1 per cent decrease in the ratio would cause a corresponding decline in demand for machinery. The study also indicated that over time improved technology had been an important source of increased demand for farm machinery.

Heady and Mayer[6] also estimated the effects of changes in farm cash receipts on the demand for farm machinery and on some individual types of farm machines. Some of these results are shown in Table 19.9. For the shorter period they suggest a very high responsiveness of farm machinery demand to farmers' cash receipts. Thus the data indicate that a 1 per cent increase in cash receipts would lead to a 3.7 per cent increase in the demand for all farm machinery and a 9 per cent increase in the demand for tractors. However, over the longer period since 1911 the estimated elasticities are much lower.

TABLE 19.9–ELASTICITIES OF DEMAND FOR DIFFERENT TYPE OF FARM MACHINES WITH RESPECT TO CHANGES IN CASH RECEIPTS RECEIVED BY FARMERS

	Derived Elasticity over Period 1911-62	Derived Elasticity over Period 1946-62
All farm machinery	0.34	3.70
Farm tractors	0.84	9.00
Farm trucks	0.50	(1)
Other farm machinery	1.21	(1)

(1)Estimates for farm trucks and other farm machinery for the shorter period, 1946-62, were inconclusive.

Source: E. O. Heady and L. V. Mayer, "Aggregate Demand for Farm Machinery", *Computers and Farm Machinery Management,* Conference Proceedings, December 1968, American Society of Agricultural Engineers, St. Joseph, Michigan, Table 3.

The paper by Heady and Mayer also made some estimates of the stock and annual demand for farm machinery for the year 1980. Thus, depending on what assumption is made about export programs and farm policies in effect at that date, a total stock of machinery, at 1965 prices, of from $38 to $48 billion was projected. The higher estimate assumes that U.S. agriculture is able to produce at full capacity with the 1965 cropland base. The lower estimate assumes a free market and U.S. agricultural exports at their 1965 level. With the present type of grain and cotton programs in effect, and with exports increasing in line with past trends, they estimate a total machinery stock of about $43 billion. Their estimates of the annual expenditures on farm machinery for 1980 were in the range of $5.3 to $5.7 billion.

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[6] E. O. Heady and L. V. Mayers, "Food Needs and U.S. Agriculture in 1980", National Advisory Committee on Food and Fibre Tech. papers, Vol. 1, Washington, D.C., 1967.

In sum, there is evidence to suggest a further significant growth in the demand for farm machinery in the United States. In the future, demand for farm machinery may be expected to have two major components. A major part will reflect demand for the work capacity embodied in this machinery—work capacity needed to handle the growing volume of agricultural output. In addition, there will be demand for a higher level of comfort and services to be embodied in machinery—services to reduce the farm workers' effort and fatigue and increase his personal comfort.

Canada – Because some two-thirds of all sales of farm machinery in Canada are concentrated in the Prairies—an area that is heavily dependent on a single crop, wheat—the Canadian market for machinery is unusually vulnerable to fluctuations in demand. Both the weather and market prices strongly affect the annual value of the wheat and other grains grown on the Prairies. Even apart from this consideration, the demand for machinery is difficult to anticipate and predict. Annual sales of farm machinery are affected by many different considerations. Consider, for example, what has happened to the total stock of machinery in use over the past 50 years. In the twenties, although tractors were coming into use, horses were still the primary power source in Canadian agriculture. The machinery in use was designed for use with horses, and for smaller farms which were best suited to this type of power. During the thirties improvements in the tractor and the development of the combine foretold the end of the horse-operated-machinery era, but the low level of farm income and farm prices prevented any substantial change at the time. The shift to the tractor-combine era was further delayed during the Second World War by the limited availability of machinery. As a result, the early postwar years witnessed a period of buoyant farm machinery sales. Two things were happening. A long period of deferred replacement was being made good. At the same time, farmers were replacing horses with tractors and were buying machinery suited to a tractor-farming operation. Binders and threshers were replaced by combines. By about 1953, the extraordinary demand created by these two influences was pretty well satisfied, and sales slumped sharply. Because the stock of machinery on farms was now relatively new, replacement demand was comparatively low.

During the post-1945 period other forces were affecting the demand for machinery as well. As labour was attracted off the farm by job opportunities in urban areas, farmers were induced to mechanize because of the scarcity of labour. The increase in farm wage rates provided an economic incentive in the same direction. In some measure, both these factors—the movement off farms and the rise in farm wage rates—vary directly with the buoyancy of employment opportunities in urban areas. Further, rising farm incomes (in terms of real income per farm operator) create a demand for machinery which reflects a direct income effect. Machinery is desired to eliminate some of the heavy labour associated with farming, to increase the amount of leisure available, and to allow the farmer to work in greater comfort.

Technological change also exerts an effect on the demand for machinery. For example, the rapid increase in the size of the farm tractor, and the shift from gasoline to the more expensive diesel engines to provide the extra power, has exerted far-reaching influences on farm machinery demand. This change made larger farms more economical and at the same time created a demand for the larger equipment needed to complement the larger tractors. While this gave an immediate stimulus to the demand for machinery, the longer-run effects on the demand for machinery may be adverse, for there is evidence that investment in machinery per acre declines as farm size increases. Moreover, the adjustment to technological change takes place slowly, since farms can be enlarged in size only as additional pieces of land become available. All of these forces interact, with varying strengths in different periods.

Thus to explain past variations in farm machinery sales and to offer any hope of forecasting future variations in demand is not an easy task. Nevertheless, the Commission sponsored some econometric analyses of farm machinery demand in Canada, and the results of these studies are described below.[7] However, before proceeding to these results it will be useful to provide some quantitative assessment of the current stock of machinery on farms, some information on the current level of sales, and some data on changes that have occurred in machinery operating and depreciation expenses over the past four decades.

Estimates derived from census data place the depreciated value of machinery and equipment on Canadian farms in 1967 at just over \$3.7 billion. This estimate includes the value of farm trucks and the farm share of passenger automobiles. Another estimate, using a different source,[8] puts the value of machinery and equipment in use on Canadian farms at \$5.5 billion. This estimate is for the 1966 stock valued at 1969 prices and is for the gross stock before depreciation. The corresponding net stock is estimated at \$2.9 billion. It excludes farm trucks and passenger cars. Corresponding to this gross stock, farmers are estimated to have charged depreciation against machinery in use (excluding cars and trucks) in the amount of \$360 million in 1968. This is about 6.5 per cent of the gross stock and 12.4 per cent of the net stock cited above. Annual expenditures by Canadian agriculture on new machinery reached a peak of about \$472 million in 1967 and have since declined moderately. Sales in 1969, about \$370 million at the farm price level, were only slightly below the total amount of depreciation on existing stocks (excluding cars and trucks), estimated at about \$400 million.

An examination of machinery operating and depreciation expenses for Canadian agriculture over the past four decades shows a significant increase in the importance of these expenses, measured either in relation to gross farm income or total farm operating and depreciation expenses. The relevant data are given in Table

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[7] The results reported here were obtained by Dr. P. S. Dhruvarajan, Department of Economics, University of Manitoba.

[8] Based on unpublished capital stock estimates prepared by Dominion Bureau of Statistics.

19.10. Thus, as these data show, machinery operating expenses increased from 7.1 per cent of gross farm income in 1927-29 to 10.6 per cent in 1967-68. As a percentage of total operating and depreciation expenses, the increase over this period was from 13.3 to 16.1 per cent. Both measures show a decline from a still higher level reached in the 1957-59 period. Similarly, estimated annual machinery depreciation charges have increased from 5.7 per cent of gross farm income in 1927-29 to 8.9 per cent in 1967-68. Measured relative to total operating and depreciation expenses, the increase was from 10.4 per cent in 1927-29 to 13.4 per cent in 1967-68.

TABLE 19.10–MACHINERY OPERATING AND DEPRECIATION EXPENSES AS A PERCENTAGE OF GROSS FARM INCOME AND TOTAL FARM EXPENSES, CANADA, SELECTED YEARS, 1927-68

	Machinery Operating Expenses as Percentage of		Machinery Depreciation Expenses as Percentage of	
	Gross Farm Income	Total Farm Expense	Gross Farm Income	Total Farm Expense
1927-29	7.1	13.3	5.7	10.4
1937-39	9.7	16.8	5.6	9.7
1947-49	8.7	18.6	4.5	9.6
1957-59	12.6	20.3	8.4	13.4
1967-68	10.6	16.1	8.9	13.4

Source: Dominion Bureau of Statistics, *Handbook of Agricultural Statistics*, Part II, Farm Income, 1926-65, Cat. No. 21-511, June 1967. DBS, *Farm Net Income*, 1969, Cat. No. 21-202, June 1970.

Econometric analyses of the demand for farm machinery attempt to identify factors which are important in influencing farmers' decisions to purchase new machinery and try to quantify their importance as a basis for forecasting future levels of demand. Demand can refer to either the stock of machinery on farms or new purchases of machinery. The stock of machinery is demanded for the annual flow of services it provides, whereas new purchases can be for replacement of existing machines or for adding to the stock of machinery in use. Economic theory argues that at any time, given the prices of machinery, the prices of other agricultural inputs such as labour and fertilizers, the prices of farm products and the cost of borrowed funds, and given the present level of farm machinery technology, there will be some stock of machinery that farmers would consider an optimum. If any of the variables listed above change, the optimum will also change and farmers will attempt to adjust their machinery stock to this new optimum for any particular farm. Their annual purchases of machinery will reflect the speed with which they attempt to reach this new optimum.

The analyses undertaken for the Commission examined changes in the stock of machinery in use on Canadian farms and annual expenditures on machinery over three separate sets of time periods–1926-67; 1926-41 and 1947-67; and 1926-41 and 1952-67. For the second and third sets of time periods, the war years were

omitted because only a very limited supply of machinery was available for purchase in that period. The third set of time periods also omitted the early postwar years from 1948-51; these were years when machinery purchases were heavily influenced by the need to make good a long period of below-normal purchases caused by the lack of purchasing power during the thirties and the lack of available supplies during the war and early postwar years. In general, the third set of time periods gave the most satisfactory results, and the results presented here are limited to these periods. The study also examined the variations in demand for different provinces or regions of Canada as well as for Canada as a whole.

One of the limitations on the farmer's ability to adjust his stock of machinery to what he considers an optimum level is the availability of capital funds to finance his machinery purchases. The study discussed here used lagged income as a rough measure of the availability of capital funds. Three different income variables were tried in the analysis: (1) total farm cash receipts, Y^c; (2) adjusted cash income, Y^a, defined as income from crops plus 60 per cent of the income from livestock and livestock products; and (3) land values, V. All were measured at constant prices. The second income variable places primary emphasis on income from field crops, on the grounds that farm machinery is still most heavily used in relation to field crops. Both lagged income and land values also reflect to some degree the farmer's expectations about future income.

Apart from these income measures, the principal variables used were the following: P_M/P_L, a ratio between the price of machinery and the price of labour; P_M/P_R, a ratio between the price of machinery and the prices received for farm products; i, total farm interest payments at constant prices; F, a measure of the average farm size; S_{t-1}, the stock of machinery on farms in a preceding period; and T, a measure of technical progress represented by time. For the first of these variables, a negative relationship is expected, since an increase in the price of farm machinery relative to the price of farm labour would discourage the substitution of capital for labour and reduce machinery purchases. For similar reasons, the second relation should also give a negative sign. The third variable, i, is intended to measure the cost of investment; as the total interest payments increases, investment would be discouraged. An increase in average farm size should lead to a more efficient use of machinery, so again a negative sign is anticipated. Finally, lagged stock has two effects: a higher stock leads to a higher replacement expenditure and thus encourages investment; on the other hand, a higher existing stock relative to other variables may lead a farmer to postpone purchases longer. The former effect should be larger and the net effect positive.

In the statistical analysis, each of the regressions was calculated three times, each time with one of the income variables Y^c, Y^a and V. It was found that in almost every case, the regression that included Y^c did better than the ones with Y^a or V. In view of this, only those regressions that included Y^c were used for further analysis, except in certain cases where, for various reasons, computer output for

regressions with Y^c was not available. In the latter case, regressions with Y^a as the income variable were used.

Using least-squares regression methods, four types of models were examined. These were as follows:

a) stock-demand equations based on stock-adjustment models,
b) investment-demand equations based on investment-adjustment models,
c) investment-demand equations based on stock-adjustment models,
d) demand equations with adjustment assumed complete within a year.

In general, the results of this analysis indicated that the most important variables in explaining changes in farm machinery sales and the stock of machinery in use on farms were lagged cash receipts of farmers, the ratio of farm machinery prices to the prices received by farmers, and the ratio of machinery prices to farm wage rates. In some results, the stock of machinery in the preceding year and time taken as a measure of technical progress also entered as important explanatory variables. Of these variables, some measure of gross farm income was much the most important. This is evident from the data presented in Figure 19.3. Fluctuations in farm machinery sales, measured in constant dollars, parallel in a general way the realized gross farm income deflated by the farm machinery price index.

The most satisfactory results in terms of the proportion of the variation in gross investment explained by the model, the level of significance, and the absence of auto correlation, were provided by the investment-demand/stock-adjustment model. The best equations obtained with this model are given in Table 19.11. Elasticities calculated from this model indicated that a 10 per cent increase in real gross cash receipts (all other things held fixed) would lead to a 19.3 per cent increase in real farm machinery purchases; a 10 per cent rise in the real price of machinery would lead to a 1.5 per cent fall in machinery purchases; and a 10 per cent rise in the price of machinery relative to labour would lead to a 2.2 per cent fall in machinery purchases. The two latter elasticities are both low compared with results cited earlier for the United States.

The Demand for Farm Machinery in Developing Countries

This section examines the prospective demand for farm machinery in the developing countries of the world. It first considers some reasons why increasing mechanization in these countries can be anticipated. It then surveys different methods that can be used to predict the future demand for farm machinery in these countries. On this basis some quantitative assessment is made of this demand.

As a group, the developing countries are characterized by low per capita incomes and recurrent or continuous shortages of food. Moreover, with their high rates of population growth and with some continued growth in per capita incomes, at least part of which will be spent on food, a substantial growth in the demand for

FIGURE 19.3 - FACTORS AFFECTING DEMAND FOR FARM MACHINERY, CANADA, 1920-69

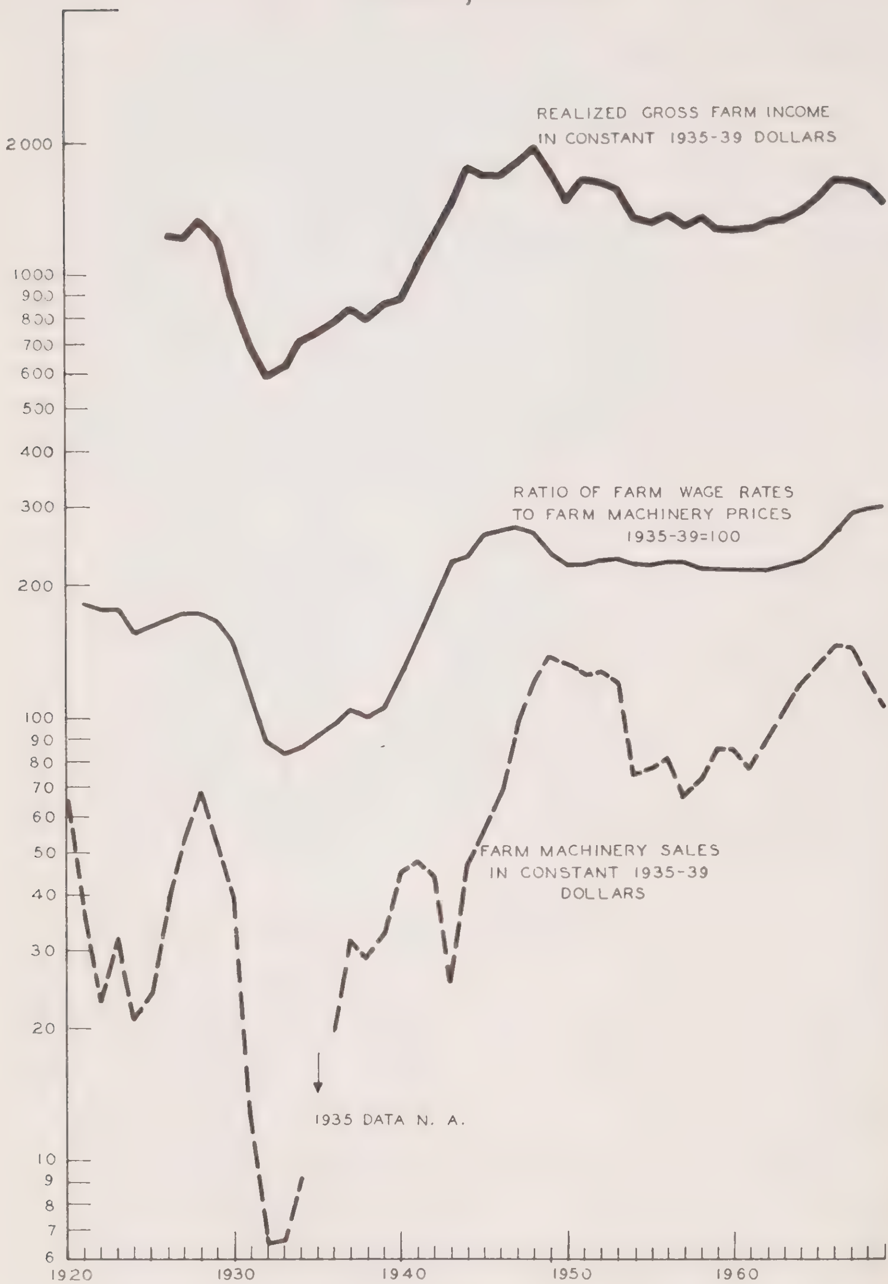

TABLE 19.11–BEST EQUATIONS: INVESTMENT-DEMAND/STOCK-ADJUSTMENT MODEL, DEPENDENT VARIABLE, I_t (GROSS INVESTMENT)

	Period	Constant Term	P_M/P_L	P_M/P_R	Y^a_{t-1}	Y^c_{t-1}	T	F	S_{t-1}	R_2	D.W.
Canada	1931-41, 1952-61	8.92 (40.56)	−20.98 (117.95)	−52.07 (95.76)	45.58 (15.92) **		1.94 (6.97)	−252.99 (1,217.58)	−.014 (.034)	.959	2.14
Quebec	1938-41, 1952-60	−.96 (.88)	−3.20 (4.61)	−1.57 (3.72)		8.05 (3.74) *			.011 (.011)	.987	1.80
Ontario	1938-41, 1952-60	21.28 (1.06) **	−9.43 (4.70)	−18.93 (4.21) **		8.01 (1.64)			−.006 (.005)	.992	2.61
Prairies	1938-41, 1952-60	102.84 (12.60) **	−40.56 (54.20)	−62.07 (38.99)		11.14 (6.43)			−.021 (.025)	.893	2.23

Note: One asterisk indicates that the coefficient is significant at the 5 per cent level. Two asterisks indicate significance at the 1 per cent level. If no asterisk appears, the coefficient is not significantly different from zero.

R_2 is the coefficient of determination and *D. W.* is the Durbin-Watson statistic. Standard errors appear in parentheses.

foodstuffs can be expected in these countries for some years to come. This suggests that the prospective demand for farm machinery in developing countries may be very large. For there is increasing evidence that mechanization affords one of the most effective ways of increasing food supplies.

The contribution that mechanization can make to increased food supplies takes three forms. First, many of these countries still use draught animals as their main source of power. A replacement of these animals by tractor or stationary engine power will release for human food many acres that are now devoted to supporting draught animals. It has been estimated that 30 per cent of the increased food supply in the United States between 1920 and 1942 came from acres formerly used to feed horses and mules. Second, modern power equipment permits greater timeliness in seeding and harvesting operations. One Indian agronomist has estimated that crop yields fall about 1 per cent per day when seeding is delayed beyond the optimum 10- to 15-day period. Finally, the increased speed of operations, made possible by tractor power, enables double or triple cropping where only one crop is possible in a draught animal economy. Each of these points will now be examined in more detail.

In the earliest stages of man's agricultural development, human energy provided his principal source of power. Human energy is extremely adaptable and versatile, but its power output is low. During continuous work one man can produce a work output of only about .1 HP.[9] Because the work output of one person was so small, agriculture based on human energy had to be divided into very small units and processes. For this reason, many years ago man began to use draught animals such as horses, mules, oxen, cattle, and donkeys to supplement human energy. This greatly increased the power available to him. One horse

TABLE 19.12–NORMAL DRAUGHT POWER OF VARIOUS ANIMALS

Animal	Average Weight (kilograms)	Approximate Draught	Average Speed of Work (m./sec.)	Power Developed (kg./sec.)	Horse-power
Horse (light)	400-700	60-80	1.0	75	1.00
Bullock	500-900	60-80	0.6 to 0.85	56	0.75
Cow	400-600	50-60	0.7	35	0.45
Mule	350-500	50-60	0.9 to 1.0	52	0.70
Donkey	200-300	30-40	0.7	25	0.35

Source: H. J. Hopfen, *Farm Implements for Arid and Tropical Regions,* FAO, Rome, 1960, p.9.

produces ten times the work output of one man and an ox seven or eight times as much (see Table 19.12). Animal power was best suited to straight pulling, as when hitched to a plow, harrow, or wagon. It could also be adapted by means of gears and wheels to various other jobs such as pumping, threshing, and crushing

[9] H.J. Hopfen, *Farm Implements for Arid and Tropical Regions,* FAO, Rome, 1960, p. 4.

sugar cane. At this stage agriculture not only provided its own source of power, it also grew the feedstuffs needed to support the draught animals used in industry and for other urban purposes. In effect, agriculture was a net exporter of power.

However, compared with the power available from a tractor, or even electric motors and stationary engines, the power provided by draught animals was still rather limited. Farmers began to use steam tractors and stationary steam engines in the nineteenth century. The tractor came into widespread use during the 1920s and 1930s. It has been greatly improved in recent decades. Equipped with rubber tires, a power take-off, a three-point hitch and hydraulics, it can be used for a wide variety of farm jobs. It is particularly suited to farms of 10 hectares (25 acres) or over in size. For still smaller farms, the power tiller is becoming an increasingly important source of power.

In agriculture, mechanization has typically been applied first in the farm yard where the controlled environment is well adapted to the use of mechanical power. Mechanization in the field and for farm transportation was more difficult because of the wide variety of environmental conditions under which the farm machine has to operate. It was only after a great many improvements had occurred in the design of tractors, combines, and other implements that it became possible to mechanize agricultural field work in a wide variety of circumstances. Even today, modern farm machinery is more adapted to the type of agriculture that prevails in North America and Western Europe than to that of the tropical and semi-tropical developing countries. And while the tractor is being increasingly used as a source of power in these countries, draught animals are still the predominant power source. This is evident from the data given in Table 19.13.

TABLE 19.13–SELECTED AGRICULTURAL STATISTICS, DEVELOPING COUNTRIES, 1966

	Africa	Asia	Latin America	Developing World
Arable land and land under permanent crops (million hectares)	216.9	328.1	109.0	654.0
Land in cereals (million hectares)	54.7	179.3	43.3	277.3
Cereal output (millions of metric tons)	45.1	200.8	55.6	301.5
Agricultural population (millions)	225.2	684.1	140.2	1,049.3
Livestock total (millions)	125.2	287.2	267.2	679.5
Cattle	119.9	280.4	234.6	634.9
Horses and mules	5.3	6.9	32.6	44.7
Tractors (thousands)	127.7	236.5	512.1	876.3

Source: FAO, *Production Yearbook, 1967,* Rome, Italy.

A study of tractor mechanization in Northwestern India shows that the annual use of 8.8 tractor hours per acre reduces the use of animal power by about

46 animal hours per acre per year.[10] Hours of human labour were reduced by almost an equal amount- namely, 48 hours per acre per year. The data from this study are given in Table 19.14. In relative terms, the impact of the tractor is much greater on the use of animal labour than on human labour. In this instance, the number of bullock hours per acre declined 75 per cent, whereas human hours fell by only 27 per cent. The impact of the tractor in replacing animal power was much greater in land preparation and in harvesting than in any other phase of the farm operation.

TABLE 19.14 EFFECT OF TRACTOR POWER ON ANIMAL POWER, AND HUMAN LABOUR UTILIZATION PER ACRE, PUNJAB, INDIA

(Hours per acre)

	Time Spent for Different Activities on:				
	Farms Using Animal Power		Farms Predominantly Using Tractor Power		
	Human Labour	Bullock	Tractor	Human Labour	Bullock
Pre-sowing	34.8	34.1	5.4	9.5	3.8
Sowing	9.2	8.1	0.1	8.0	6.7
Post-sowing	22.7	–	–	12.2	–
Irrigation	12.7	3.9	–	14.6	4.3
Manuring	2.0	0.7	0.3	3.6	–
Harvesting	81.4	12.7	2.8	69.8	0.2
Miscellaneous	11.8	2.2	0.2	9.4	0.6
Total	174.6	61.7	8.8	126.9	15.6

Source: Adapted from Bhagat Singh, "Economics of Tractor Cultivation – A Case Study", *Indian Journal of Agricultural Economics,* Vol. XXIII, No. 1, January-March 1968, p. 85.

As these data show, in Asia, Africa, and Latin America there are one billion people–roughly one-third of the world's population–dependent on agriculture. These people own and employ 680 million animals, of which 635 million are cattle and 45 million are horses and mules. As of 1966 they owned about 877,000 tractors or about one for every 800 head of livestock. While not all these animals are used for draught purposes, a great many are. In Asia and Africa the ratio of livestock to tractors is more than 1,200 to 1. There is clearly a very large potential for the replacement of animal power with tractor power. These countries currently have about 1.3 tractors per 1,000 hectares of arable land. This contrasts with 44 in Western Europe and 24 in North America.

The value of the tractor as a substitute for animal power is enhanced by the extremely seasonal character of most farming operations. During the tillage, planting, and harvesting seasons–often only a few months of the year -animal power tends to be used to the limits of its capacity. During much of the year, animals are idle or used only occasionally. They must still be fed and looked after.

[10] Bhagat Singh, "Economics of Tractor Cultivation – A Case Study", *Indian Journal of Agricultural Economics,* Vol. XXIII, No. 1, January-March 1968, p. 85.

With the increasing use of electric motors and diesel engines for stationary work in developing countries, the period when animal power is idle is tending to lengthen. This increases the relative cost of animal power.

In addition, the adoption of new high-yielding grain varieties, the use of more fertilizer, and the practice of multiple cropping is intensifying the demand for power during the critical tillage, planting, and harvesting periods. As a result, the limited supply of animal power available during such periods becomes a bottleneck, limiting the scope of the farming operation. Farmers are shifting to tractors as a method of removing this bottleneck. Moreover, there is some evidence that net income per acre is higher on tractor-using farms than on farms that rely on animal power. This confirms the view that the tractor is becoming an economic substitute for draught animals as a power source in these countries.[11]

Unlike the traditional varieties, the new higher-yielding varieties of grain developed in Mexico, the Philippines, and elsewhere are highly responsive to fertilizer, water, improved tillage, and better cultural practices. Their success will require changes in nearly all the components of farm production technology in these countries. This will include the increased use of power and implements.

The increased yields that arise with better timing and precision in farm operations result from a number of sources. Reference was made earlier to the loss in yield through delay in seeding. The slowness with which human or animal power performs farming operations can result in other losses as well. One man working one hectare of land by hand will require from 20 to 30 days' hard labour for a single spading. In the meantime weeds will be growing back, and productive time will have been lost. With animal power the same land may be cultivated in from four to seven days, and the loss will be smaller. With tractor power, time lost is reduced to a minimum. As one author observes, "moreover, when the rainy season is short, rapid land preparation ensures good weed control and the best use of the rainy season. Following the harvest of the rice crop, rapid land preparation and reseeding also make use of the residual soil moisture to grow a crop of wheat, grain sorghum or pulses."[12] The same author cites a number of experiments where better seeding equipment and more precise placement of fertilizer resulted in substantial increases in yields. He also cites evidence that improved timing in harvesting and threshing helps save a larger proportion of the crop, and results in an improved quality product. In areas where moisture is assured or irrigation water is available, the shift towards multiple cropping is facilitated by the use of the tractor. It greatly reduces the time required to prepare the land, seed, and harvest successive crops.

Before turning to a more detailed examination of the different sources of demand for farm machinery in developing countries, it will be useful to examine

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[11] *Ibid.*, p. 83.

[12] L. Johnson, cited in G.W. Giles, *World Food Problems: Basic Needs*, a paper presented at the Annual Meeting of the American Society of Agricultural Engineers held jointly with the Canadian Society of Agricultural Engineering, June 1967.

the relation that exists between the value of agricultural machinery and draught animals in use, and the value of agricultural output. A recent analysis of the ratio between these two totals by Colin Clark has shown that this ratio has varied over a comparatively narrow range, both over time in individual countries and between different countries at the same date in time.[13] Thus, for India in 1961, this capital output ratio was .58, that is, the value of draught animals and implements was equal to about 58 per cent of the annual value of agricultural output, net of the input of seed and feed. In Lower Saxony, West Germany, for 1956, the study showed a ratio of .34 for small farms and .27 for larger farms. In the United States in 1949-51 the ratio was .47, only slightly different from the ratio of .52 in 1870 and .48 for 1880. Only in *hand-hoe agriculture* is the ratio substantially lower than this. In this latter case, it is usually between .1 and .2. Some of these data are summarized in Table 19.15.

TABLE 19.15 – CAPITAL-OUTPUT RATIOS IN AGRICULTURE, INDIA, WEST GERMANY, AND THE UNITED STATES, SELECTED YEARS

		Ratio of Value of Draught Animals and Implements to the Annual Value of Agricultural Output
India	1961	.58
West Germany	1956	.30
United States	1870	.52
	1880	.48
	1890	.55
	1900	.53
	1910	.62
	1919-21	.70
	1924-26	.58
	1929-31	.55
	1939-41	.40
	1949-51	.47

Source: From C. Clark, "Capital Requirements in Agriculture: An International Comparison", *The Review of Income and Wealth,* No. 3, September 1967, Tables 2, 5, and 11.

This comparatively stable relationship suggests that further increases in agricultural output in developing countries will be accompanied by a corresponding growth in the use of machinery. Thus the primary source of demand for machinery in these areas will be to replace draught animals and to provide for an increased supply of power and other equipment as total agricultural output increases. In addition, existing stocks of equipment must be replaced as they wear out.

Several approaches can be taken towards estimating the potential demand for tractors and other farm machinery in developing countries. One approach is to consider the amount of equipment that would be required to raise the power

[13] C. Clark, "Capital Requirements in Agriculture: An International Comparison", *The Review of Income and Wealth,* No. 3, September 1967, p. 205.

available in developing agriculture to certain minimum levels. Another approach is to project recent trends in the growth of tractor use in developing countries. Still another approach is to estimate the amount of tractor power that would be needed to replace animal power in agriculture. Let us consider each of these approaches in turn.

The first approach was used in some estimates of future tractor and other farm machinery requirements prepared for a publication entitled *The World Food Problem.*[14] This study first examined the relation that exists in different countries between the yield of various crops and power used per acre (see Figure 19.4). As the data in this chart show, the more advanced agricultural countries, which produce outputs of 2,000 kilograms or more per hectare, make use of from 1.0 to 2.5 HP per hectare of land. In contrast, as shown on Table 19.16, at the present time, available horsepower per hectare of arable land and land under permanent crops is only .19 in Asia, .05 in Africa, and .27 in Latin America. After examining past trends this Report concludes that it is reasonable to assume that Latin America could achieve a power use of .5 HP per hectare by 1986, Asia a level of .33 HP per hectare by 1998 and Africa .20 HP per hectare by 1998. The estimates make no allowance for the replacement of animal power by tractor power but simply assume an increase in power available, all to be supplied by tractors.

On this basis these experts concluded that annual expenditure for tractors would more than double before 1986 (see Table 19.17). However, estimated expenditures for all other equipment including animal-drawn machinery would change relatively little over the period. No reasons are given for the comparatively constant level of the non-tractor components of machinery expenditures.

TABLE 19.16–AVAILABLE HORSEPOWER PER HECTARE OF ARABLE LAND AND LAND UNDER PERMANENT CROPS, BY REGION

	Asia[1]	Africa	Latin America	United States	Europe
Tractor (riding)	.02	.03	.18	1.00	.78
Garden tractor	.03	.00	.00	.014	.02
Animal	.09	.01	.05	.00	.08
Human	.05	.01	.04	.003	.05
Total	.19	.05	.27	1.02	.93

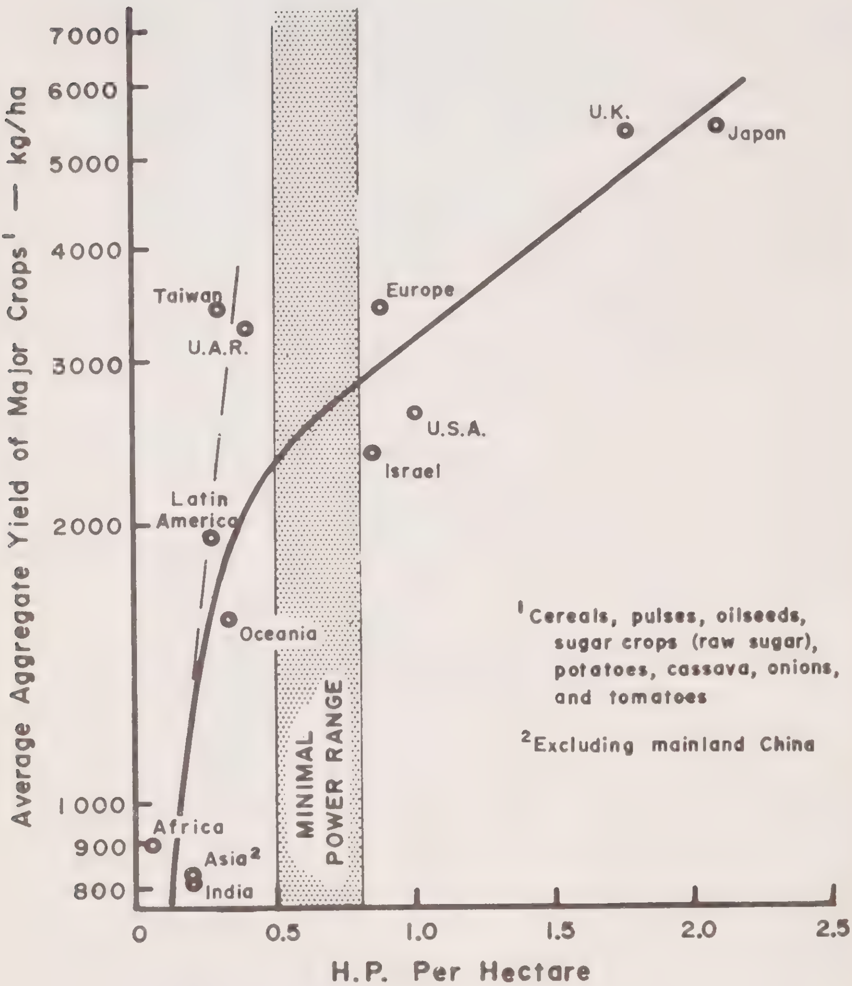
[1] Excluding mainland China and Japan.

Source: *The World Food Problem,* A Report of the President's Science Advisory Committee, Vol. II, The White House (Washington: U.S. Government Printing Office, May 1967), p. 397.

[14] A report of the President's Science Advisory Committee, Vol. II, The White House (Washington: U.S. Government Printing Office, May 1967).

FIGURE 19.4 - RELATIONSHIP BETWEEN YIELDS IN KG/HECTARE AND POWER IN HORSEPOWER PER HECTARE

MAJOR FOOD CROPS



SOURCE: PRESIDENT'S SCIENCE ADVISORY COMMITTEE, THE WORLD FOOD PROBLEM, VOL. II (WASHINGTON: U.S. GOVERNMENT PRINTING OFFICE, MAY 1967).

TABLE 19.17–ESTIMATED ANNUAL COST TO FARMER, TRACTORS AND OTHER FARM MACHINERY, DEVELOPING COUNTRIES, ASIA, AFRICA AND LATIN AMERICA, 1966-86[1]
(Millions of U.S. dollars)

	1966-70	1970-76	1976-86
Tractors	368	494	786
Other machinery	1,022	1,018	1,021
Total	1,390	1,512	1,807

[1]Excluding mainland China and Japan.

Source: *The World Food Problem,* A Report of the President's Science Advisory Committee, Vol. II, The White House (Washington: U.S. Government Printing Office, May 1967), p. 401.

A second approach to estimating demand for farm machinery in the developing areas is to project the growth in demand experienced over the past decade or more. Data for this purpose are available for tractors only. Table 19.18 shows the number of tractors on farms, in the world as a whole and in developing countries, over the period 1954-66, together with the growth rate over this period. Tractors in use in developing countries have been increasing more rapidly than in the world as a whole. As a result the developing countries' share of the world total has increased from 4.6 per cent in 1954 to 6.3 per cent in 1966. However, if allowance could be made for the horsepower size of tractors in use, it is doubtful

TABLE 19.18–TRACTORS ON FARMS, WORLD TOTAL, AND DEVELOPING COUNTRIES, 1954-66[1]

	World Total	Developing Countries	Developing Countries as a Percentage of Total World
	('000)	('000)	
1954	8,010	366	4.6
1955	8,643	411	4.8
1956	9,150	466	5.1
1957	9,639	525	5.5
1958	10,094	504	5.0
1959	10,488	552	5.3
1960	10,888	598	5.5
1961	11,325	635	5.6
1962	11,808	639	5.4
1963	12,411	699	5.6
1964	12,917	763	5.9
1965	13,362	809	6.1
1966	13,811	876	6.3
	Compound Growth Rate (Per cent)		
1954-66	4.6	7.5	

[1]Data exclude mainland China. As far as possible, data are for tractors used in agriculture. However, a few countries report total tractors in use, including garden tractors.

Source: FAO, *Production Yearbook,* 1956 through 1967 inclusive.

TABLE 19.19–PROJECTIONS OF TRACTORS IN USE IN DEVELOPING COUNTRIES, BY REGION, 1966-85

	Asia	Africa	Latin America	Total Developing Area
		(Thousands)		
1966	237	128	512	876
1970	378	157	681	1,216
1975	679	203	971	1,853
1980	1,220	263	1,386	2,869
1985	2,191	340	1,978	4,509
		Compound Growth Rate (Per cent)		
1966-85	12.4	5.3	7.4	9.0

Note: Totals may not add due to rounding.
Source: Commission estimates.

whether the developing countries have increased their share of the total horsepower in use on farms, for the shift to larger-horsepower tractors has been very pronounced in Canada, the United States, Australia, and several other countries.

A projection of tractor stocks in developing countries by major region, for the period 1966 to 1985, is given in Table 19.19. If the net increase in tractor stocks is converted to average annual totals and is then multiplied by $3,000 (representing the price of a small tractor), to convert them to a dollar total, the following estimates are obtained:

	Annual Expenditure for Tractors
	(Millions of dollars)
1966-70	255
1970-75	384
1975-80	609
1980-85	984

Although the data are not for precisely comparable time periods, the latter estimate does not differ very substantially from the one presented above in Table 19.17. Moreover, this latter estimate includes the growth in stocks only and thus makes no allowance for replacement demand. However, it may imply some replacement of animal power by tractor power.

Still another approach to assessing the demand for farm tractors is to consider tractor power as a potential replacement for animal power. Assuming some continued growth in the stock of animal units (horses, cattle, caribou, and mules) on farms in developing areas, it is reasonable to assume that the total number in 1970 was about 750 million. No precise basis exists for estimating how many

of these were being kept for milk or raised for beef rather than used for draught purposes, but 150 million appears to be a reasonable estimate. On this basis the current stock of draught animals amounts to 600 million. Suppose half of these were replaced by tractor power over the next 30 years. This would require the replacement on the average of 10 million animal units per year. What would be the tractor equivalent of this?

Earlier in this section it was noted that in India 8.8 tractor hours had replaced about 46 animal hours. This is a ratio of 5 to 1. In Canada between 1941 and 1956 the stock of horses on Canadian farms declined by just over two million while the stock of tractors increased by 340,000. This suggests that one tractor replaced about six horses. If the 5-to-1 ratio is used, it would require two million tractors to replace 10 million animal units. This would mean an annual demand for tractors, presumably of the smaller 30-to-35 HP variety, of two million per year for the next 30 years. When this is compared with the present stock of tractors on farms throughout the world—14 million in 1966 and perhaps 15 million today—or with the current world tractor output of about 700,000, it is evident that the potential requirement for tractors in developing countries is enormous. Requirements are not, of course, effective demand. Nevertheless, the tractorization of farming in developing countries may be one of the most effective ways of solving the world's food problem. For that reason, as the world's population continues to increase, more and more pressure may develop to help realize this potential tractor requirement.

A comparison with the two other estimates of this potential demand for tractors as animal replacement makes it clear that the last estimate implies a very much larger expenditure. Two million tractors implies an expenditure in the order of $6 billion annually. Thus it is clear that the earlier estimates imply only very limited animal-power replacement.

A more sophisticated approach to estimating the demand for tractors would distinguish between tractors and two-wheel power tillers. The latter have begun to receive extensive use in countries where small farms predominate, such as Japan. This is evident from the data in Table 19.20 on the extent of farm mechanization in different countries. The experience of advanced countries is that when the tractor is first adopted, it is used mainly on larger farms. However, as mechanization proceeds, the availability of the tractor begins to influence the size of farms, and farms become progressively larger.

The modern farm tractor would appear useful on farms of 10 hectares or more. For farms of less than 10 hectares, the power tiller is likely to be more suitable. Thus data on the number of farms in different developing countries which are above or below 10 hectares in size may provide some indication of the potential demand for tractors and power tillers. In time, of course, as mechanization proceeds, the availability of tractors may lead to a consolidation of many of the farms that are now below 10 hectares in size. Table 19.21 provides some data on

TABLE 19.20 FARM MECHANIZATION IN SELECTED DEVELOPED COUNTRIES

	Average Arable Land Holding	Four-wheel Farm Tractor[1]	Two-wheel Power Tiller	Tractor Horsepower per Hectare of Arable Land
	(Hectares)	(Thousands)		
United States	38.7	4,625	525	1.51
Britain	13.8	389	48	1.51
France	9.4	1,060	380	1.29
West Germany	5.5	1,107	100	2.43
Italy	3.6	377	75	0.76
Japan	1.1	28	2,490	2.20

[1] All 1964, except Britain (1963) and Japan (1966).

Source: I. Hayashi and S. Miyoshi, *Features of Japanese Rice Farm Machinery,* Society of Automotive Engineers, West Coast Meeting, San Francisco, Calif., August 12-15, 1968.

TABLE 19.21–NUMBER OF FARMS AND PROPORTION OF ACREAGE IN DIFFERENT SIZE GROUPS, DEVELOPING COUNTRIES, 1960

	Number of Farms		Percentage of Acreage in Farms	
	Under 10 Hectares	10 Hectares and Over	Under 10 Hectares	10 Hectares and Over
	(Thousands)			
Colombia	926	284	8.8	91.2
Brazil	1,499	1,839	2.5	97.5
Peru	803	67	8.5	91.5
Venezuela	218	102	2.9	97.1
Paraguay	104	46	2.3	97.7
Uruguay	26	61	0.7	99.3
Ceylon	1,156	14	61.4	38.6
Lebanon	122	5	60.2	39.8
Philippines	2,045	121	66.7	33.3
West Pakistan	5,303	387	57.3	42.7
East Pakistan	6,438	26	95.2	4.8
Iraq	175	78	5.0	95.0
Iran	1,563	314	40.0	60.0
India	31,748	2,606	63.4	36.6
Turkey	2,122	406	39.3	60.7
Libya	71	75	5.9	94.1
Senegal	277	18	73.9	26.1
Total	54,594	6,448		

Source: Based on data compiled from FAO, *1960 World Census of Agriculture,* other unpublished data provided by FAO, and agricultural or land-holding censuses of individual countries.

the number of farms in these two size groups for a number of developing countries. For the 16 countries for which data are available, there were, in 1960, 54.6 million farms of less than 10 hectares and 6.4 million farms of 10 hectares or over. Some of the farms in the former group, of course, might be so small that they would not justify even a power tiller.

Demand for other machinery is very difficult to estimate because data on the amount of this machinery in use are very limited. Data presented earlier suggest that annual expenditures on all farm machinery, excluding tractors, in both North America and Western Europe amount to about 120 per cent of annual expenditures on tractors. On this basis, if it is assumed that total expenditures on machinery, excluding tractors, are roughly equal to expenditures on tractors, an expenditure of \$6 billion annually is implied in this area as well. For the developing region this implies an annual expenditure of about \$18 per hectare of arable land, including land under permanent crops. This compares with an expenditure by Canadian farmers in 1967 of about \$11 per acre, equivalent to about \$27 per hectare, of improved land. For the most part, the developing areas engage in a much more intensive type of agriculture so that higher expenditure levels for a fully mechanized agriculture may be justified. However, the very size of the expenditure levels implied suggests the magnitude of the problem that will be involved in mechanizing agriculture in the developing countries.

In concluding this discussion, it may be desirable to consider briefly the amount of research expenditure that is currently devoted to developing improved machinery for use in the agriculture of developing countries. As was noted earlier, about one-third of the world's population is dependent on agriculture in developing countries. Yet the amount of research and development expenditures oriented to improving the machinery and equipment used by farm workers and farmers in these countries has been very limited. The National Institute of Agricultural Engineering in England had a small research program oriented to this task, but their total expenditure amounted to little more than a few hundred thousand dollars. Some of the major farm machinery companies may have made some expenditures oriented to agriculture in these countries; Ford recently announced a new tractor designed for use in developing areas. But the overwhelming proportion of the world's research expenditures on farm machinery is oriented to the agriculture of developed countries rather than developing countries. Although no totals are available here, it is clear that total annual expenditures on research and development in the former area is very large. Total research and development expenditures by the farm machinery industry in the United States in 1960 were reported as \$75 million. Expenditures by two major companies, Deere and Massey-Ferguson, have doubled since that date. In addition, there are significant expenditures by industries in other countries, especially Western Europe, and by governments in both Europe and North America. Thus total world expenditures may well exceed \$200 million annually. Compared with this, the amount spent for improving machinery suited to the agriculture of developing countries is very small indeed.

This suggests that there may well be very large returns from a research and development program designed to improve machinery for use in developing areas. One aspect of such a program, meriting particular attention, would be the development of improved machinery for use with the farm tractor in developing countries. Accordingly, the Commission recommends to the Canadian International Development Agency a careful study of the desirability of encouraging the establishment of several research institutes in different parts of the developing world, the task of which would be the development of improved machinery for use with tractors or power tillers in these countries.

Chapter 20

THE FUTURE OF THE CANADIAN INDUSTRY: AN EVALUATION

The Commission was asked to examine

> the present and prospective competitive position of the Canadian agricultural machinery industry in Canadian and in export markets as compared with agricultural machinery industries in other countries, including an examination of research and development activity and its relationship to the establishment of new facilities in Canada.

It was also asked to consider and report upon

> measures that would contribute to the expansion of efficient production of agricultural machinery, the attainment of technological advances, the improvement of distribution, financing and servicing facilities and the enhancement of the industry's competitive position so that Canadian farmers would be ensured most favourable prices for, and availability of, machinery and parts.

The present section of the Report has reviewed a number of considerations that have a direct bearing on the competitive position of Canadian manufacturing firms in both the Canadian and world market. This chapter will summarize some of these factors and outline some steps that could be taken to improve the industry's present competitive position.

In examining this question it is useful to distinguish between Canadian firms that are subsidiaries of major international enterprises and the smaller independent Canadian firms. The former group currently account for about 80 per cent of the value added by the industry in Canada and have long held a dominant position. There is also some reason to believe that the major international companies have been gaining an increasing share of the world trade in farm machinery. However, a number of the independent firms have enjoyed rapid growth in recent years, and although precise data are lacking, it seems likely that their share of Canadian output has been increasing. For the subsidiaries of major companies any decision to expand Canadian production will be made in the context of an assessment of the worldwide interests of the international company. In the short run this decision may be dominated by the availability of productive capacity in one country rather than another. In the longer run, these international enterprises will locate their

production in the lowest-cost country, taking full account of manufacturing costs, transport costs, tariffs and various production risks and including in this assessment prospective changes in these costs in the near-term future. For in a jet age these global corporations find it increasingly easy to use their management, marketing, and research skills to source machines and components from the lowest-cost location on a worldwide scale and to market their products on a broad international basis.

However, for newer products initial production will often be located close to the research and development unit where the product was designed and developed. New products often go through a period of progressive development in their early stages of use, and it is economical to keep the factory responsible for it close to the design engineers who originated the basic idea. Thus one way to influence the location of manufacturing is to influence the location of research and development units. Moreover, given the strong labour-saving emphasis that characterizes most new developments in farm machinery, these new products often find their earliest acceptance in high labour-cost areas. Thus for these companies the key to expansion in Canadian output lies in the encouragement of more research and development in Canada.

The independent Canadian firms view the production-location decision from a much narrower viewpoint. Until they reach a size where a subsidiary manufacturing plant in another country becomes feasible, they are likely simply to expand their original plant. Given the cost advantages of their location and the efficiency with which they manage their manufacturing operations, their success is likely to depend largely on their ability to identify markets which they are well equipped to enter. For example, two firms that have enjoyed substantial growth in recent years—Versatile and Thomas Equipment—have successfully identified markets which they were equipped to satisfy. For Versatile this success lay in the production of machines well suited to the Prairie grain-growing areas in Canada and the United States. For Thomas Equipment it was their successful innovation of potato-harvesting equipment, well suited to the stony soils of Maine and the Maritimes. However, in the longer run the smaller independent firms may be handicapped in competing with the international giants unless they receive some support on the research and development side from government or university research facilities.

As has been outlined in some detail in earlier chapters, the world market for farm machinery can be conveniently grouped into three major areas—North America (Canada and the United States), Western Europe, and the rest of the world. At the present time the first two areas are far the most important in absolute size, with markets in 1965 of around \$3.6 billion and \$2.6 billion, respectively. In the rest of the world, the developing areas are an important subgroup. Although their present market is fairly small in absolute size—these countries accounted for just 6 per cent of the farm tractors in use in 1966 (excluding mainland China)—it is likely to be a rapidly growing market in the future. Over the past two decades,

the market in Western Europe has grown much more rapidly than the North American market, and this pattern is likely to continue for some years to come.

Of these three markets, it is the North American market that is, by a wide margin, the most important to the Canadian producer and this is likely to continue to be true. Except for specialty products, the European market is likely to be difficult for the Canadian producer to penetrate. Not only are there tariff barriers to overcome, but, in addition, ocean transport costs for traffic moving from east to west are higher than in the reverse direction, and manufacturing costs are significantly lower in Western Europe than they are in North America.

On the other hand, although the North American market has a comparatively slow rate of growth in absolute size, it is a rich and diverse market and probably has a more rapid rate of new product development and acceptance than is true for any other market area.

Moreover, the location of the Canadian industry is still well suited to the manufacture of machinery for the North American market. The major disadvantage faced by manufacturing plants in Ontario is that of being somewhat away from the centre of the North American market. However, as was shown in Chapter 16, this disadvantage in terms of transport costs for the finished product is more than offset by lower manufacturing costs, although the recent appreciation of the Canadian dollar will have reduced this advantage. Manufacturing plants in Winnipeg enjoy much lower manufacturing costs than those in the United States, and while this advantage is partially offset by its distance from some of the major market areas, it is in a strong competitive position to cater to markets in the western part of the continent. Some of these same cost advantages may be present in other Prairie locations as well. At the present time Canadian manufacturing plants account for about 7 to 8 per cent of manufacturing shipments and value added by the industry in North America. At the same time, about 12 per cent of all farm machinery sales in the two countries takes place in Canada. Thus the Canadian manufacturers' share of the North American market is well below Canada's share of total sales. Even a modest increase in Canada's share of the market would mean a fairly major increase in total Canadian production. To raise it to 12 per cent would require more than a 50 per cent increase in total output.

If one considers the four leading manufacturers of farm machinery in Canada—Massey-Ferguson, International Harvester, Deere, and White Motor—it is clear that there are very wide variations in the share of their North American sales which they choose to source from plants in Canada. The reasons for this variation are far from clear, but they may well include both historical development and company philosophy. Of these four companies, Massey-Ferguson provides much the largest share of its sales on this continent out of Canadian plants. Because the total market grows slowly, once a complex of plants has been established, any change in location is likely to take place slowly. Massey's plants at one time catered to an important off-shore export market, and for this reason some of its production

facilities are well in excess of what is needed to satisfy the Canadian market alone. Massey's one major new plant in Canada the combine plant at Brantford—was located there partly because of special tax incentives for locating in areas of above-average unemployment.

The second most important manufacturer of farm equipment in Canada -International Harvester—produces its machinery in a plant in Hamilton which was first established in 1908. However, its Canadian production, as a proportion of the parent company's total North American sales, is very much smaller than that of Massey-Ferguson. For Deere and White Motor, Canadian manufacturing output represents a still smaller share of the parent company's total sales on this continent. It is hard to explain on rational economic grounds why there should be such a wide variation in the share of total North American sales sourced from Canadian plants. However, it is probably not accidental that the firm with the largest share manufactured in Canada is owned and controlled in Canada. A number of other North American firms with substantial sales in Canada, such as Case, Allis-Chalmers, New Holland, and New Idea, do not manufacture any of their machinery in Canada, although Case has some machines produced on a contract basis by independent Canadian manufacturers.

Probably the most important single step that can be taken to induce these firms to increase their Canadian manufacturing production is to strengthen greatly the research and development base for this industry in Canada. A number of recommendations designed to achieve this goal are contained in Chapter 17. Over the longer run the implementation of these measures will do much to encourage an increased amount of farm machinery manufacture in Canada. Up until now research and development in agricultural machinery in Canada has been extremely weak. Very little research has taken place either in the federal and provincial governments or in Canadian universities. And many of the major firms that manufacture in Canada have done a disproportionate share of their research in the United States. With improved support for research and a strengthening of graduate programs in agricultural engineering in Canadian universities, and with a greatly expanded research program by the Federal Government, the whole atmosphere for research will be greatly improved. The industry should find this atmosphere conducive to an expansion of their own research program in Canada. And an expansion in their Canadian research facilities will lead in time to an increase in their manufacturing output in Canada.

The smaller independent Canadian firms should benefit from the expansion in Canadian research facilities as well. Not only will new developments in farm machinery be provided by this research, but the development of these facilities will provide a much larger number of personnel with expertise in agricultural engineering whose services can be drawn upon on a consulting basis, or who can be recruited to form part of the permanent staff of these firms.

The smaller Canadian companies should also benefit from a greater input of management know-how. Many of these firms are too small to afford the specialized management resources of large organizations. Their product designs, plant engineering, production control, quality control, and financial management would all benefit from higher quality inputs. Perhaps one of the best ways the government could aid such companies would be to underwrite the costs of management consultant studies, which could identify areas of potential improvement in their operations, and then provide financial support for a limited time to implement the changes recommended.

PART IV

THE MECHANIZATION OF AGRICULTURE

Chapter 21

THE DEVELOPMENT OF FARM MECHANIZATION

Canadian farming in the last quarter century has experienced a technological revolution. Its most visible form has been mechanization. Facilitated by many advances in non-machinery technology, mechanization has had far-reaching effects on farming structure, production techniques and management methods.

Economists often distinguish between two types of technological change. *Output increasing* innovations result in increased production from a given level (or cost) of inputs, and they include new crops or varieties and agricultural chemicals. *Cost reducing* technology enables a given level of output to be produced from a reduced level (or cost) of inputs. Such economies arise from the substitution of one type of input for another, such as machinery for labour. The distinction collapses, however, once it is seen that any particular technological innovation can be either output-increasing or cost-reducing or both, depending on how it is applied and what other adjustments in production are associated with its application.

No matter how it is labelled, technological advance can ultimately be viewed as the development of new or better inputs which may lead to a higher output, or substitute for more traditional inputs and enable cost reductions. Thus, in one sense all technological change can be viewed as a process of "factor substitution".

Agriculture reached its present level of mechanization through a prolonged evolutionary development. In its earliest stages the farmer made his own tools and equipment, first from wood and then from metal. In time, as the tools in use improved, specialized local tool makers appeared. This was the age of the blacksmith. Over the recent and much shorter period, the latter has been replaced by the manufacturer who builds and distributes his machines in large volume. The machines have become increasingly sophisticated and specialized.

Parallel to this evolution of farm machinery and its mode of manufacture have been changes in the use of power in farming. At first, man was the only source of power. Since one man can produce only about one-tenth of a horsepower, the tools that could be used and the farming operations that could be carried out were very limited. With the harnessing of domestic animals, mainly horses and oxen,

there was a great increase in the power man could apply and the amount of food that could be produced. Improved implements were devised to take advantage of this power.

Much more recently we have seen the application of mechanical power to farming, first with steam and then the internal combustion engine. Used initially as stationary engines, they were soon adapted to field operations in the form of the steam-powered and then the gasoline-powered tractor. The electric motor, the diesel engine, the rubber-tired and the caterpillar tractor were soon to follow. With the introduction of hydraulic transmission of power it became possible to use the same power unit for various lifting operations as well as for traction, and for operating other machines through the power take-off. As a result of these changes the power that can be applied and controlled by one man has steadily increased.

In this capsule history of agricultural development, certain landmarks stand out. The moldboard plow facilitated more effective tillage and initial weed control. Subsequently, the seed drill permitted more even seeding and by facilitating weed control in the growing crop, made possible the use of crop rotations. The use of draught animals for power had far-reaching effects on society as a whole for it allowed man to spend increasingly less time on food production, thus freeing labour for many non-farm activities. With the introduction and improvement in mechanical power sources this trend has steadily accelerated. Its effective limits have not yet been reached. Nevertheless, the massive and far-reaching changes of the last 50 years have caused greater adjustments in farming than in any previous period of ten times its length. For Canadian agriculture, a description of some of these recent changes is provided in the next chapter.

These changes in the farm equipment in use, the farmer's power sources and the way his machines are manufactured have produced and been accompanied by changes in the farmer's role in society. Initially, the farmer made his own tools and produced food largely for his own use. His position has gradually evolved into one where he markets most, if not all of his product, and buys a great range of machinery and other inputs from specialized suppliers.

In Canada, four overlapping phases can be distinguished in this agricultural development. First came the *ranging agriculture* of the native Indian tribes. Primitive in nature, making use of natural objects and artifacts, it was no match for the formal *land settlement* type of agriculture introduced by the Europeans. The eighteenth and nineteenth centuries witnessed the gradual spread of largely self-supporting often isolated, family farms. This type of farming spread through Upper and Lower Canada and the Maritimes and subsequently across the Prairies. Although these farmers often adopted indigenous crops such as corn to great advantage, many of their ideas and methods came from Europe.

With the coming of the steamship, the canal and the railway, Canadian farmers soon began exporting some of their surplus grain and other produce to Europe, importing breeding stock, farm equipment and other manufactured goods

in exchange. Faced with a perpetual labour shortage in relation to the land area available, there was a strong incentive for North American farmers to devise improved labour-saving machines. This in turn stimulated local manufacture of farm machines, a development that was so successful it soon led to a thriving export business in farm machinery. By the 1860s Canadian companies were making sizable exports of farm machines to the United States, Europe, and Australia.

From the beginning of this century until 1945 a third phase of Canadian agriculture characterized by *farm expansion* is discernible. As population grew, communications improved and trade developed, more land was cleared and brought under cultivation. There was a massive growth in the area of farmland and the number of farms, in agricultural output, in population on farms, and in the farm labour force. Situated on the edge of the Prairies, Winnipeg grew from a town of 2,000 in 1890 to a city with one-quarter of a million inhabitants by 1940.

The farms of the expansion era were characterized by larger acreages, by specialization in fewer enterprises and by extensive mechanization. The period saw the introduction and growing use of the tractor to replace horses and the early use of the combine harvester.

Subsequently, changing pressures have led to a period of *agricultural adjustment*. Many of the pressures were economic, arising from changing national and world circumstances. The result has been an increase in farm size, a major movement of people out of farming and the full development of agriculture as a specialist economic activity. At the farm level this has meant much larger and more sophisticated tractors and other farm machines, a much greater variety of equipment to choose from and an increasing reliance on machinery of all kinds. It has also meant more dependence on off-farm suppliers for production inputs and for expert services. As a result, the farm is taking on many of the characteristics of businesses in other sectors of the economy. It is with this transition and all the dynamic changes of this recent period that this section of the Report is concerned.

Chapter 22

THE CHANGING PATTERN OF CANADIAN AGRICULTURE

Canadian agriculture in the twentieth century has been moulded by the pressures of expansion and adjustment and a continuous process of technological change. Some of the effects of these interrelated changes are described and charted in the following pages.

Structural Changes in Farming

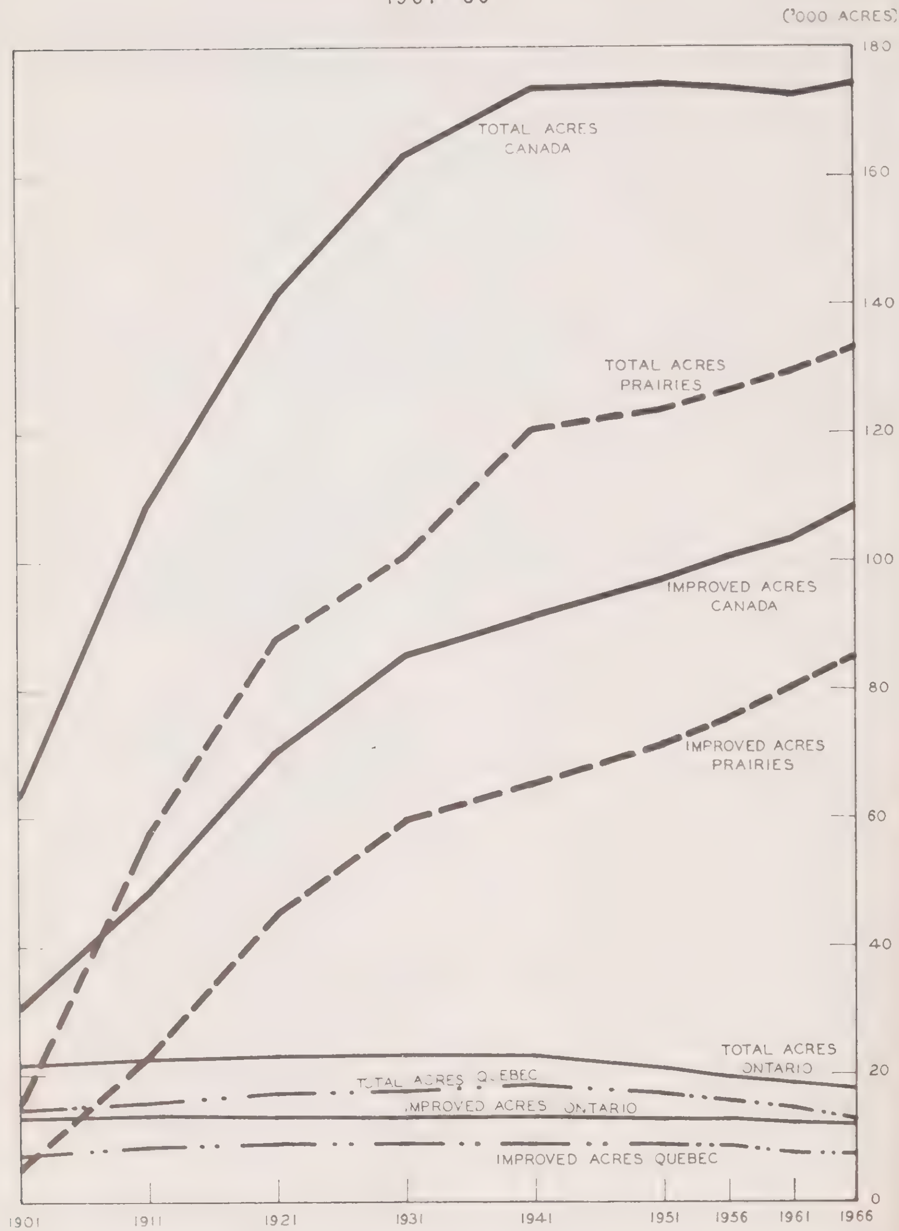
Agricultural Area – Virtually all the Canadian expansion of farmland between 1901-41 occurred in the Prairie Provinces, where the area in farms grew eightfold. Since 1945, the total area of farmland in Canada has remained almost constant and has actually declined in Ontario and Quebec with urban growth, reforestation and the abandonment of marginal farms.

In contrast, the area of improved land has grown consistently throughout this century. While it initially made up about half of the increasing total area of farmland, it has continued to expand since 1941 until now about 62 per cent of the total land in farms is classed as improved. The result has been an effective enlargement in farm size. The results of these changes are shown in Figure 22.1.

Farm Numbers – As the agricultural area grew so did the number of farms. New farms were established mainly on the Prairies. In Quebec there was little growth, while in Ontario, since 1921, the number of farms has fallen. From 1945 on, faced with the need for greater efficiency to survive, farm numbers began to decline in all regions of Canada. Much of the decline has been for farms of 200 acres or less. On the Prairies, even larger farms have been under pressure and only holdings of more than 640 acres have increased in number. While the pressures to form larger units are not as strong in Ontario and Quebec, where livestock and mixed farming are more prevalent, farms with less than 200 acres have been declining here as well as can be seen from Figure 22.2.

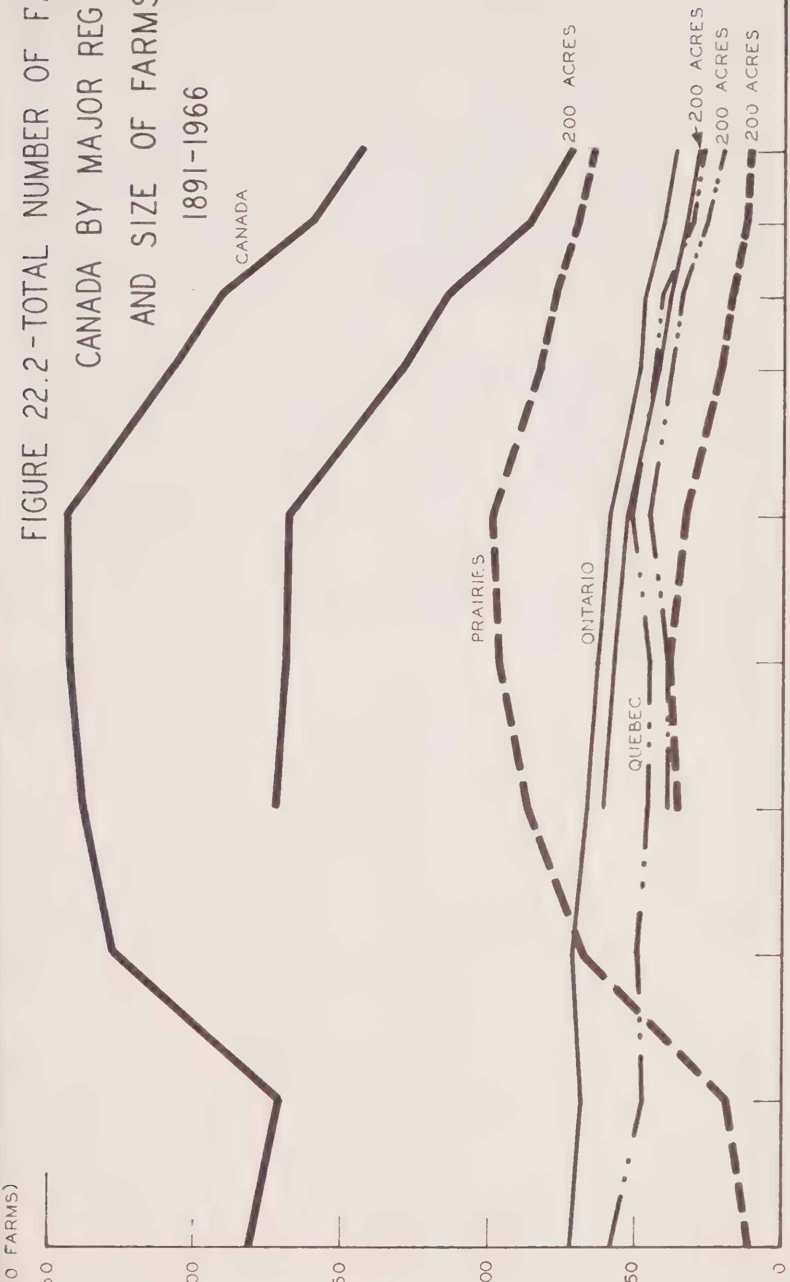
Farm Size Structure – The result of these changes has been an increase in average farm size. On the Prairies the average size of farm has doubled between 1921 and 1966, increasing to 685 acres. Larger farms have always been prevalent on

FIGURE 22.1-AREA IN FARMS, CANADA BY MAJOR REGIONS, 1901-66



SOURCE: BASED ON DATA FROM CANADA DEPARTMENT OF AGRICULTURE, SELECTED STATISTICAL INFORMATION ON AGRICULTURE IN CANADA, OCTOBER 1969.

FIGURE 22.2 - TOTAL NUMBER OF FARMS, CANADA BY MAJOR REGIONS AND SIZE OF FARMS, 1891-1966



SOURCE: BASED ON DATA TAKEN FROM CANADA DEPARTMENT OF AGRICULTURE, <u>SELECTED STATISTICAL INFORMATION ON AGRICULTURE</u>, OCTOBER 1969.

the Prairies. Still, 41 per cent of all farms in this region were of less than 200 acres in 1921. This had fallen to 18 per cent by 1966. By contrast, in Ontario and Quebec the smaller farm has been dominant and even today three-quarters of these farms are of less than 200 acres. In these provinces the average size of farm has grown more slowly increasing over this period only from about 120 to 160 acres.

Farm Organization and Tenure With the growth of corporate farms, co-operative farming ventures and part-time farms, the traditional family farm has lost some ground. Despite the fall in the total number of farms, holdings classified as "part-time" in the Census of Canada have doubled since 1951, numbering 130,000 in 1966. They now form the majority of so-called "non-commercial" farms, and constitute as much as 30 per cent of all farms, compared with 10 per cent in 1951.

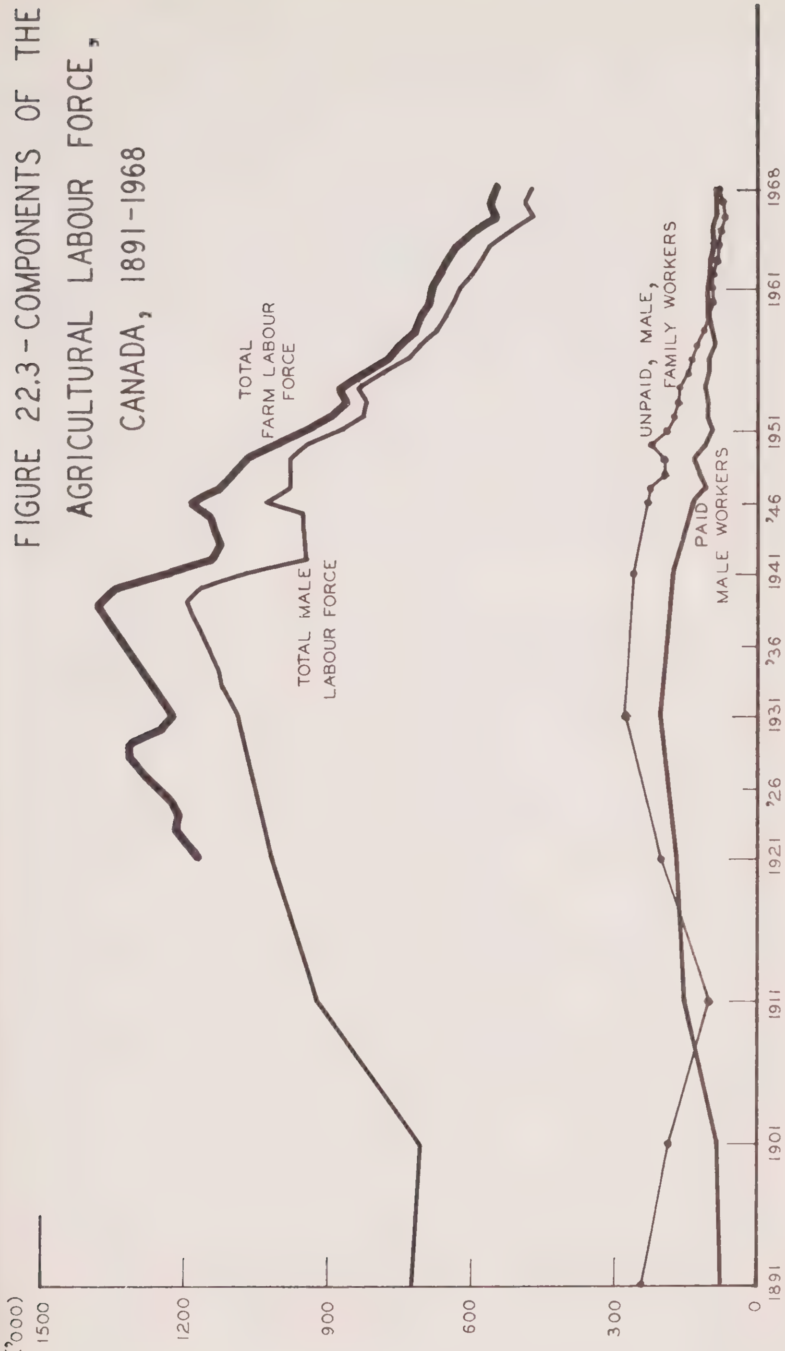
Similarly, the pattern of land tenure has undergone a major transformation. In 1941, 12.9 per cent of Canadian farms (with 15.7 per cent of the total farm acreage) were operated by tenants. By 1966 this proportion had fallen to 4.6 per cent of the number of farms and about the same proportion of total farm acreage. Yet over the same period the percentage of fully-owned farms and farmland declined slightly. The greatest change was in farms that are part-owned and part-rented: this class doubled its share of the total farms over the 25-year period, and increased its proportion of the farmland area from 28 to 44 per cent. Most of these changes reflect the steps taken by successful owner-farmers to increase their farm size by renting additional land.

Similar adjustments are evident at the provincial level. In Quebec, some 90 per cent of farms are fully owned by their operators. Pure tenancy is almost non-existent. The period since 1941 has seen a small growth in the proportion of mixed-tenure farms. On the Prairies tenancy has been more widespread, perhaps because of the simplicity with which share-crop leases can be arranged. Even so, over the 25 years ending with 1966, the region has experienced a decline in the proportion of fully-rented farms from 21 per cent to less than 7 per cent. The proportion of owned farms has remained steady at 60 per cent while the proportion in the part-owned and part-rented category has increased. Farm enlargement has evidently been accompanied by a decline in full tenancy and a growth in combined ownership and rental. A similar pattern is evident in Ontario.

Labour Force – During the early part of the century the farm labour force expanded along with agriculture as a whole, reaching a peak about 1939. Since then there has been a large and steady decline (see Figure 22.3). The movement of labour away from the farm was stimulated by the attractions of non-farm employment. It has been made possible by the increased use of farm machinery as a substitute for labour.

More detailed examination of the data reveals that most of this labour loss has been in farm operators and family labour. In contrast, the decline in the hired

FIGURE 22.3 - COMPONENTS OF THE AGRICULTURAL LABOUR FORCE, CANADA, 1891-1968



SOURCE: BASED ON DATA FROM M. C. URQUHART AND K. A. H. BUCKLEY, EDS., HISTORICAL STATISTICS OF CANADA, TORONTO: THE MACMILLAN COMPANY OF CANADA LTD., 1965; DOMINION BUREAU OF STATISTICS, CANADIAN LABOUR FORCE ESTIMATES.

labour force has been very modest. Apparently, farm amalgamations have often caused whole families to leave the land.

In 1901 some 40 per cent of the Canadian labour force was employed in agriculture. By 1969 this proportion had fallen to less than 7 per cent. The national total masks strong regional variations, reflecting differences in the type of farming and the importance of agriculture in different regions. The Prairies show a relatively high proportion of the total labour force engaged in agriculture, but even there the figure has declined from 48 per cent in 1941 to 17.4 per cent in 1968. An even greater relative decline took place in the Central Provinces: in Quebec the decline was from 21.5 per cent in 1941 to 5.4 per cent in 1968, and in Ontario from 18.6 per cent to 4.9 per cent. The most dramatic decline was in the Atlantic Provinces, where by 1968 only 4 per cent of the labour force was engaged in agriculture, one-sixth of the proportion in 1941.

Because farm numbers were falling during this period also, there has been no parallel decline in the average labour force per farm. It fell only from 1.51 in 1951 to 1.26 in 1966. Accordingly, acreage worked per man almost tripled between 1941 and 1966, rising to 200 improved acres for Canada as a whole, and to 355 on the Prairies.

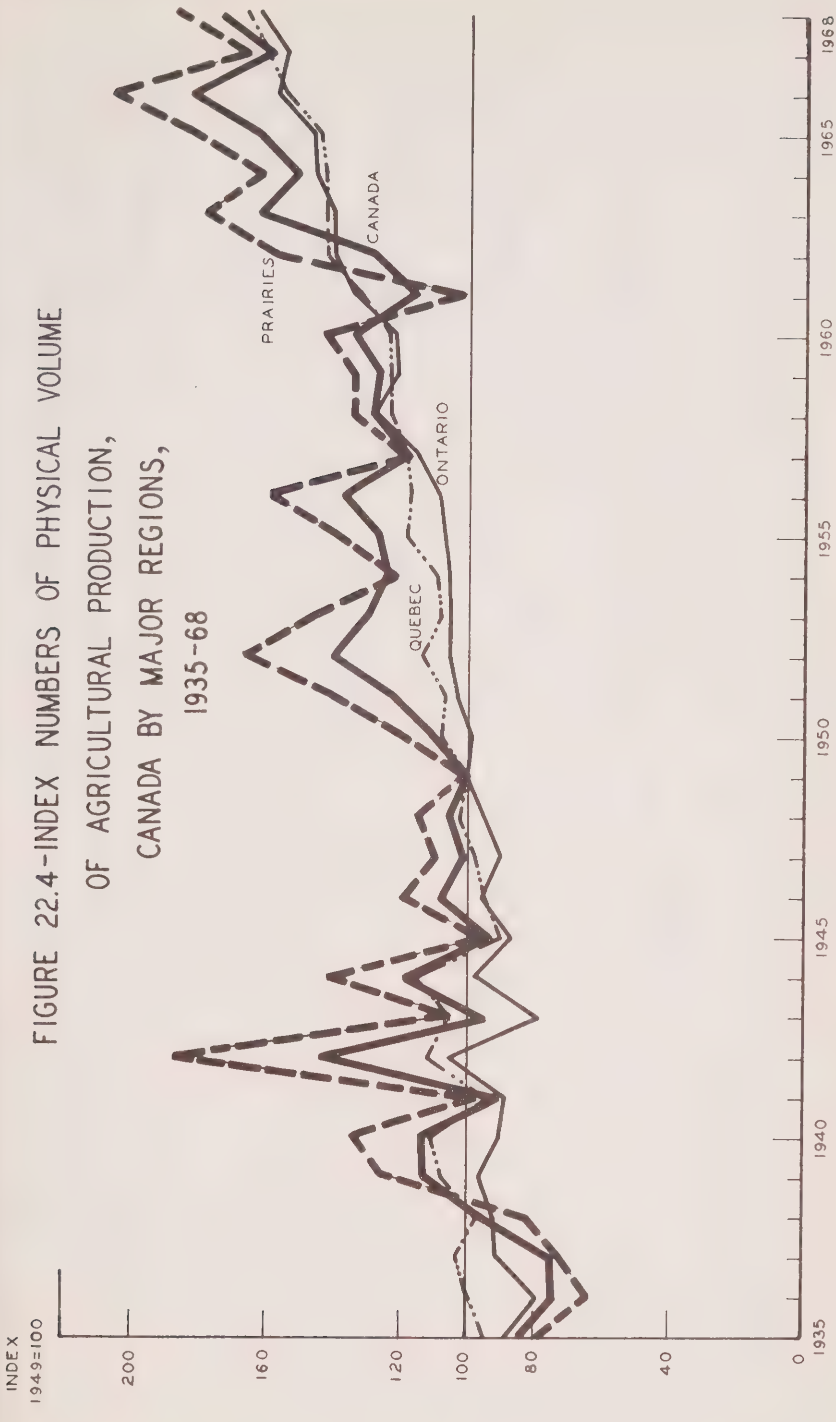
Agricultural Output – Despite this large decline in the farm labour force, agricultural output, aided by improved technology, has shown an upward trend (see Figure 22.4). All provinces have shared in this growth, the Prairies to the greatest extent: 53 per cent of Canadian agricultural output came from this region in 1966, compared with 43 per cent in 1941.

Still, in all regions the relative importance of agriculture has fallen sharply. Agricultural output amounted to 12.8 per cent of Gross Domestic Product in 1951. It accounted for only 4.6 per cent in 1967.

As the total area of farmland has not increased since 1941, the higher output levels imply an increased productivity from the available land. Some of this has been the result of land improvement. Increasing yields per acre have also contributed. Figure 22.5 shows the trend of yields for selected crops over the past 60 years. For some crops a rising trend is clearly evident. For others, such as wheat, yields are only marginally higher than they were early in this century. In part, this may reflect the emphasis that plant breeders have placed on disease resistance and milling quality rather than yield.

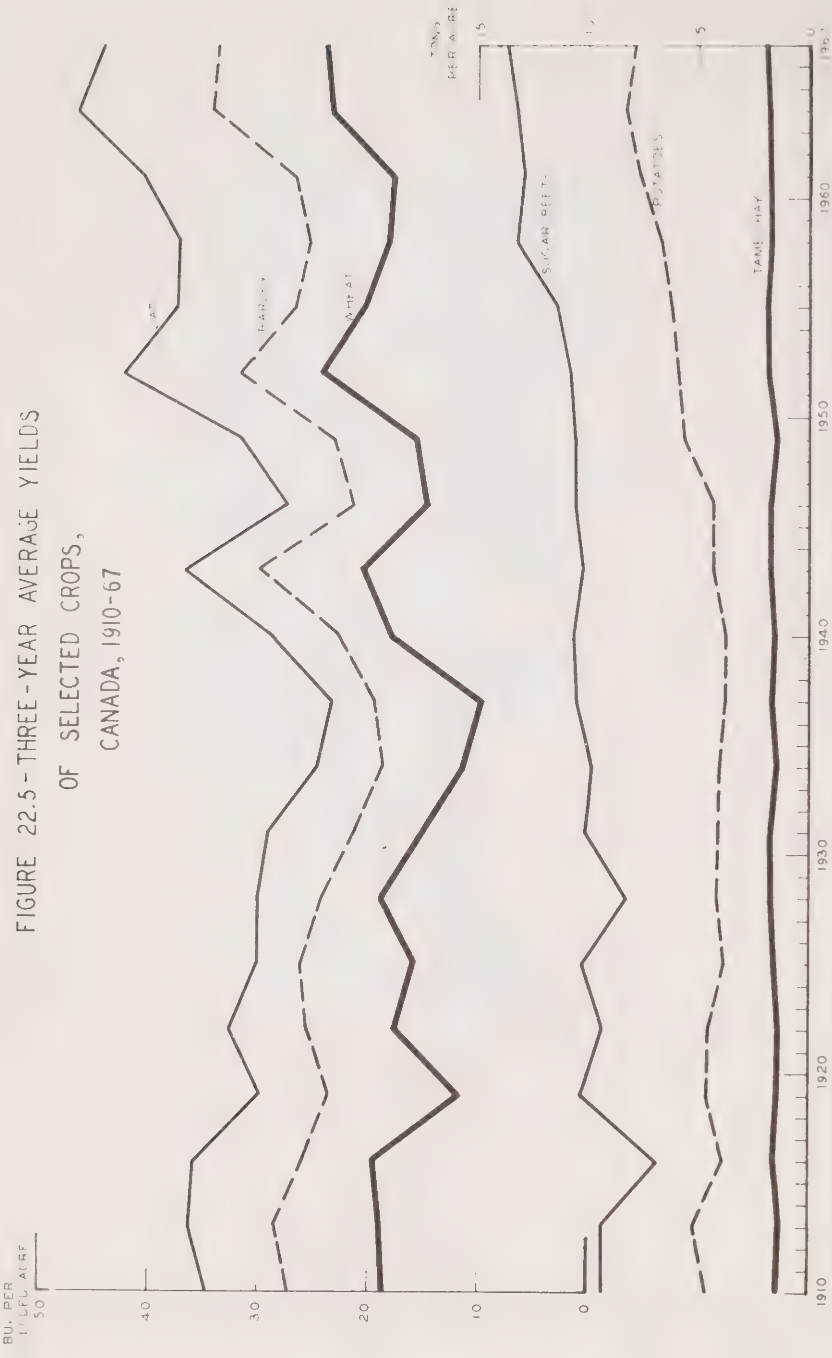
Machine Numbers and Types – That farms could lose so much labour and still increase their output is due in no small measure to the progress of agricultural technology, particularly to machine technology. Mechanization has thus played a double role, catering for both an increased output and a decline in the labour force. In addition, as will be seen later, by altering the whole nature of agriculture it has created its own set of pressures and problems.

FIGURE 22.4–INDEX NUMBERS OF PHYSICAL VOLUME OF AGRICULTURAL PRODUCTION, CANADA BY MAJOR REGIONS, 1935–68



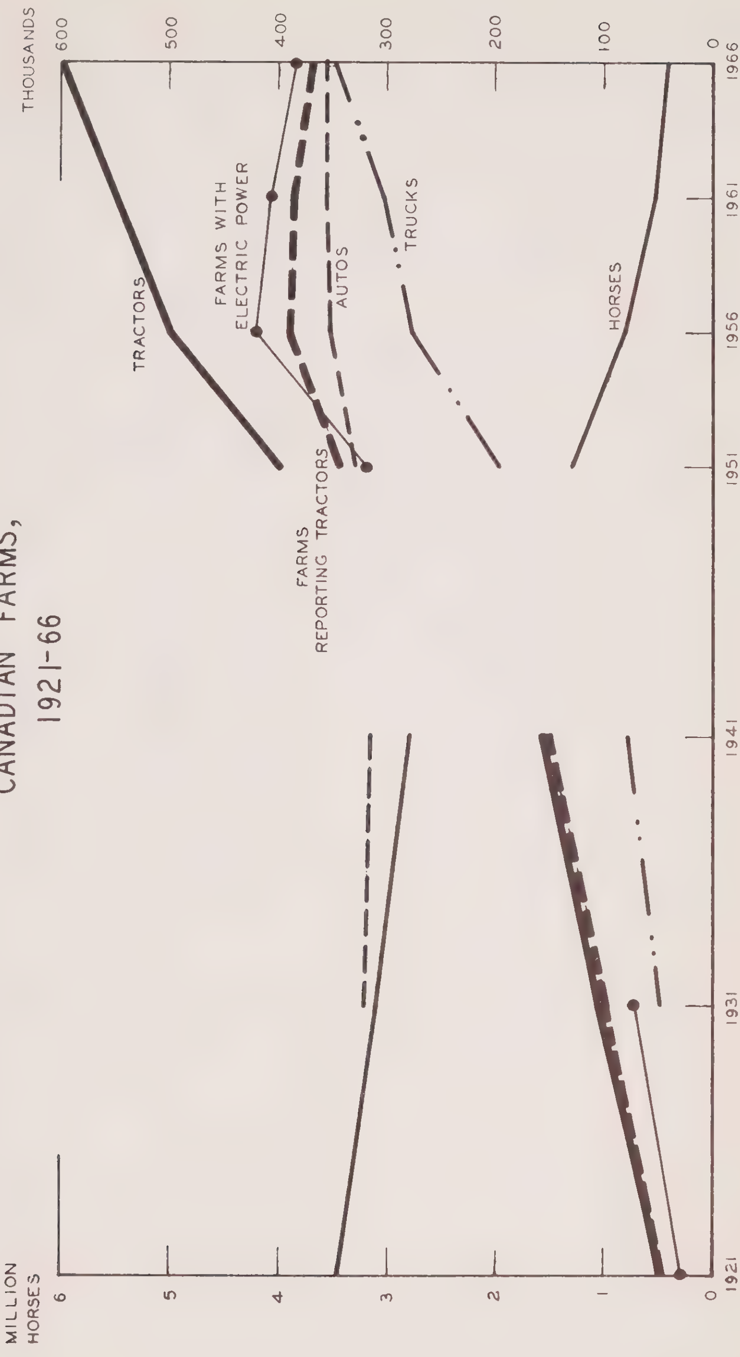
SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, <u>INDEX OF FARM PRODUCTION, 1968</u>, CAT. NO. 21-203.

FIGURE 22.5 - THREE-YEAR AVERAGE YIELDS OF SELECTED CROPS, CANADA, 1910-67



SOURCE: DOMINION BUREAU OF STATISTICS, AGRICULTURAL DIVISION, CROPS SECTION, HANDBOOK OF AGRICULTURAL STATISTICS, PART I, FIELD CROPS, 1908-63, CAT. NO. 21-507, MARCH 1964, AND UNPUBLISHED DATA SUPPLIED TO COMMISSION BY THE CROPS SECTION OF THE AGRICULTURAL DIVISION OF DBS.

FIGURE 22.6 - SOURCES OF POWER, CANADIAN FARMS, 1921-66



SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, <u>CENSUS OF CANADA, 1966</u>, TABLES 7 AND 8.

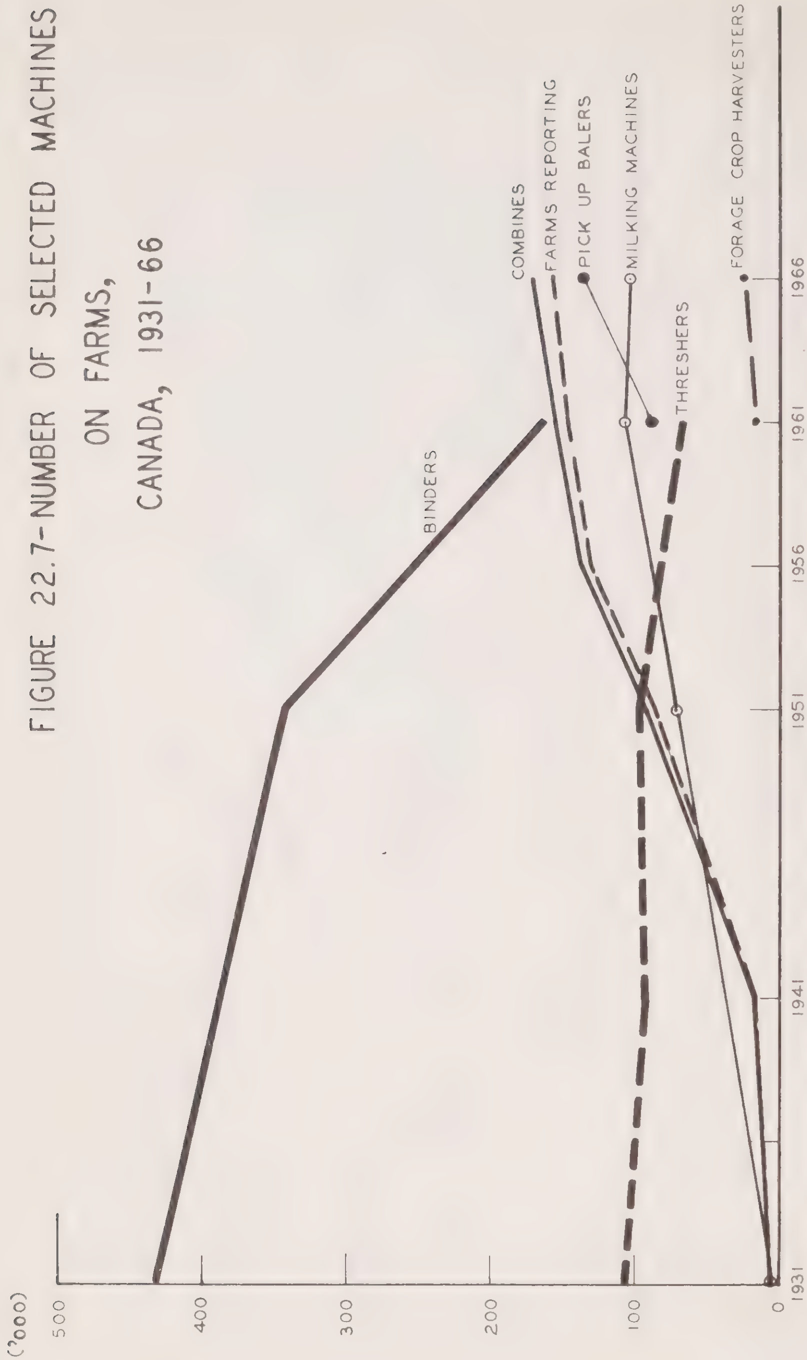


FIGURE 22.7-NUMBER OF SELECTED MACHINES ON FARMS, CANADA, 1931-66

SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, CENSUS OF CANADA, 1966, TABLE 7, AND HISTORICAL STATISTICS OF CANADA, M. C. URQUHART AND K. A. H. BUCKLEY, EDS., TORONTO, MACMILLAN, 1965.

The use of machinery as a source of power and as a substitute for labour is shown in Figures 22.6 and 22.7. The growth in tractor numbers, mirrored by the decline in the horse population, proceeded at a steady rate until 1941, then accelerated. Between 1941 and 1951, the number of farms with tractors more than doubled. With the further growth in numbers since that time, there were, by 1966, about 1.4 tractors in use per occupied farm. A similar if less pronounced growth has occurred in the use of trucks and electric power.

The increase in the use of combines followed a similar pattern. Replaced by the combine, the number of binders and threshing machines with their high labour requirement has fallen sharply.

The postwar period has seen a change in the characteristics of farm machines, as well as in their number, and the engineering technology and work capacity of modern farm machinery has reached a high level. Tractors have increased greatly in power and sophistication. Before 1947, no tractors with a power rating above 30 HP were available. Even in 1960, two out of every three new tractors sold were in the under 35 HP category. This compares with 4 per cent today. By 1967, 30 per cent of all the farm tractors sold in Canada were in the 80 HP and over size class, a size sold by only one major company prior to 1959. The dominant fuel type in use has shifted strongly towards diesels, a move closely related to the trend to higher horsepower models. In 1953, only 13 per cent of the new tractors sold were powered by diesel engines. By 1967, some 78 per cent of the total and virtually all tractors over 80 HP were diesel-engined. As a result, sales of tractors in terms of horsepower have continued to rise steadily even though the number of new units sold has shown little change (see Figure 22.8).

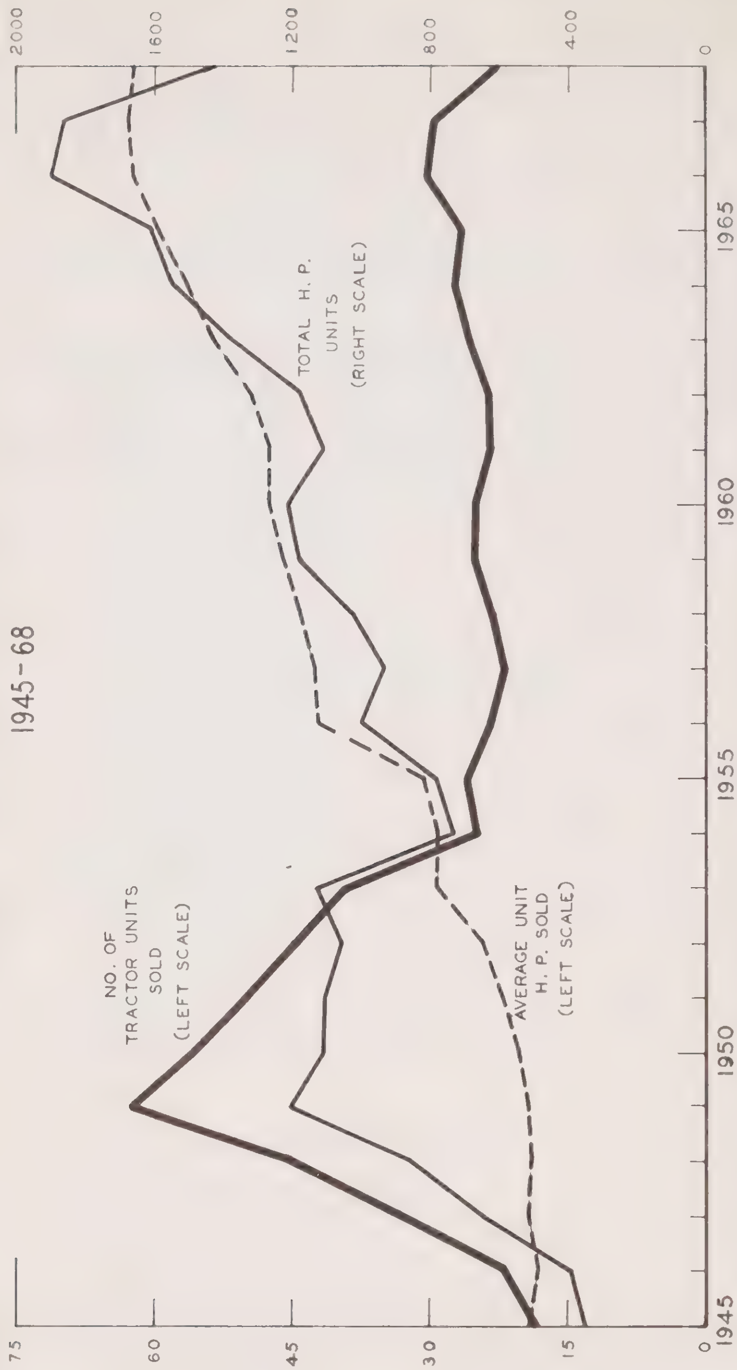
The trend to larger tractors has been particularly strong on the Prairies. Over 50 per cent of the new units purchased by Prairie farmers in 1966 had in excess of 80 HP, with only 5 per cent of purchases being units with less than 40 HP. At the other extreme, virtually none of the very large units are sold in Quebec, where roughly 60 per cent of all sales are for tractors below 40 HP.

Regional differences in the rate of "tractorization" are shown in Figure 22.9. The Prairies and Ontario were the first to adopt the tractor in large numbers. But by the mid-1950s, it was a basic item of equipment on farms in all provinces.

Economic Patterns in Agriculture

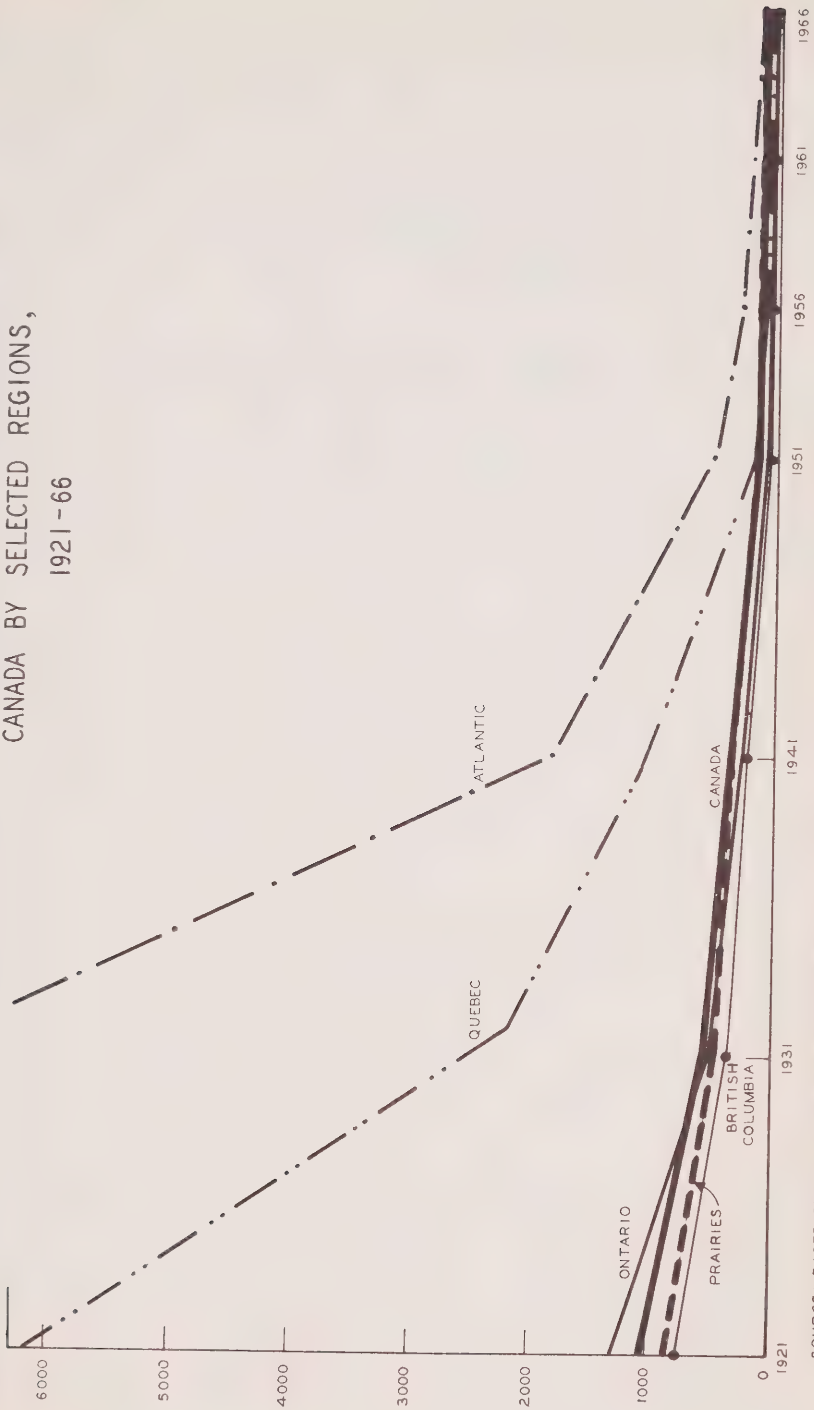
Farm Revenues – During the early expansion phase of Canadian agriculture the value of farm products sold climbed steadily, then began to sag with the decline in prices in the late 1920s and slumped badly during the Great Depression. After 1933 prices gradually recovered and farm production began to expand again. Throughout the postwar adjustment phase, the combination of a rising volume of output and inflation in the prices received for farm products has provided farmers with a growing level of cash receipts. This rising trend has been further strengthened

FIGURE 22.8 - TRACTOR SALES
CANADA, BY NUMBER AND HORSEPOWER,
1945-68



SOURCE: DOMINION BUREAU OF STATISTICS, *FARM IMPLEMENT AND EQUIPMENT SALES*, CAT. NO. 63-203 (OTTAWA: QUEEN'S PRINTER), VARIOUS YEARS, AND COMMISSION ESTIMATES SHOWN IN TABLE A2.

FIGURE 22.9 - CROP ACRES PER TRACTOR, CANADA BY SELECTED REGIONS, 1921-66



SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, CENSUS OF CANADA, AGRICULTURE, VARIOUS YEARS.

by the growing commercial orientation of farming, whereby an increasing proportion of production is sold rather than consumed on the farm.

In general, the price indexes for livestock products have risen more than for crop products (see Figure 22.10). This reflects the shift in the pattern of food products consumed as incomes grow, coupled with a more rapid growth in productivity for field crops as compared with livestock products. In consequence, though the physical volume of output of both livestock and crop products have grown at much the same rate in Canada, total cash receipts from the former have increased faster than from the latter.

Farm Costs – The level of farm expenditures has shown a similar pattern of changes, declining as the general price level fell during the depression but rising continuously thereafter. Most of this increase, however, can be attributed to the rise in the index of prices paid for farm inputs. Thus, although the level of farm operating expenses (in current dollars) has increased by a factor of 5.5 since 1935, the real increase in constant (1935-39) dollars is a little over 1.5 times. There was a sharp rise in prices of all inputs during and after the Second World War and an especially large and sustained increase in wage rates. Farm machinery prices, too, have risen consistently since price controls were lifted in the late 1940s.

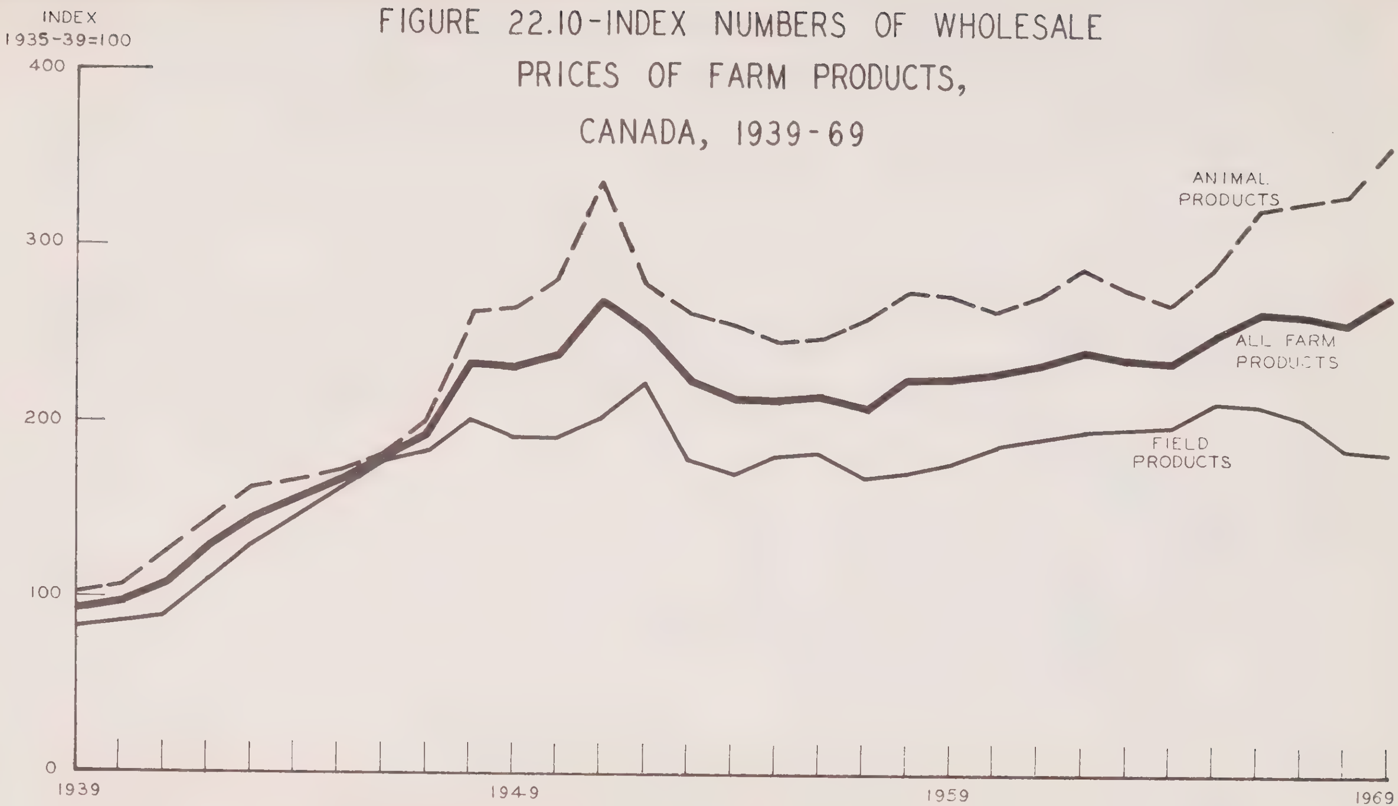
Farm Incomes – The path of farm incomes throughout this century is similar to the over-all pattern of farm costs and revenues. Certain differences arise, however, from two sources. Firstly, net incomes are determined by gross incomes, which include the value of produce utilized for farm consumption, inventory changes, and various subsidiary payments, as well as the cash receipts from sales of produce. Secondly, the paths of gross income and costs, although similar, have not experienced an identical growth throughout the period. Consequently, the difference between them, net income, reflects a particular pattern of its own.

Total net farm income suffered a severe decline during the early 1930s as the Canadian agricultural sector, in common with that of the United States, was hit hard by drought and depression (see Figure 22.11). Recovery was slow but steady until 1941. Thereafter farmers enjoyed a rapidly growing, if fluctuating, income. The peak was reached in 1951 when production and prices were at a high level, but for the subsequent three years product prices fell sharply while farm costs continued their rise. Total farm income dropped accordingly and did not show any significant rise until the 1960s.

To obtain a more realistic picture of farm incomes, several adjustments may be made. First, the effects of inflation can be removed to give the real purchasing power of income in constant dollars. Even so, the wide year-to-year fluctuations characteristic of agricultural production obscure the trends, which may be clarified by applying a moving average. Finally the net income per farm operator is perhaps the more meaningful measure of agriculture's prosperity.

Accordingly, Figure 22.12 shows the time path of real total net income (1949 dollars) and income per farm operator smoothed by a 4-year moving average. This

FIGURE 22.10-INDEX NUMBERS OF WHOLESALE PRICES OF FARM PRODUCTS, CANADA, 1939-69



SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, PRICES AND PRICE INDEXES, CAT. NO. 62-202 AND CANADIAN STATISTICAL REVIEW, HISTORICAL SUMMARY, 1963 EDITION, CAT. NO. 11-502.

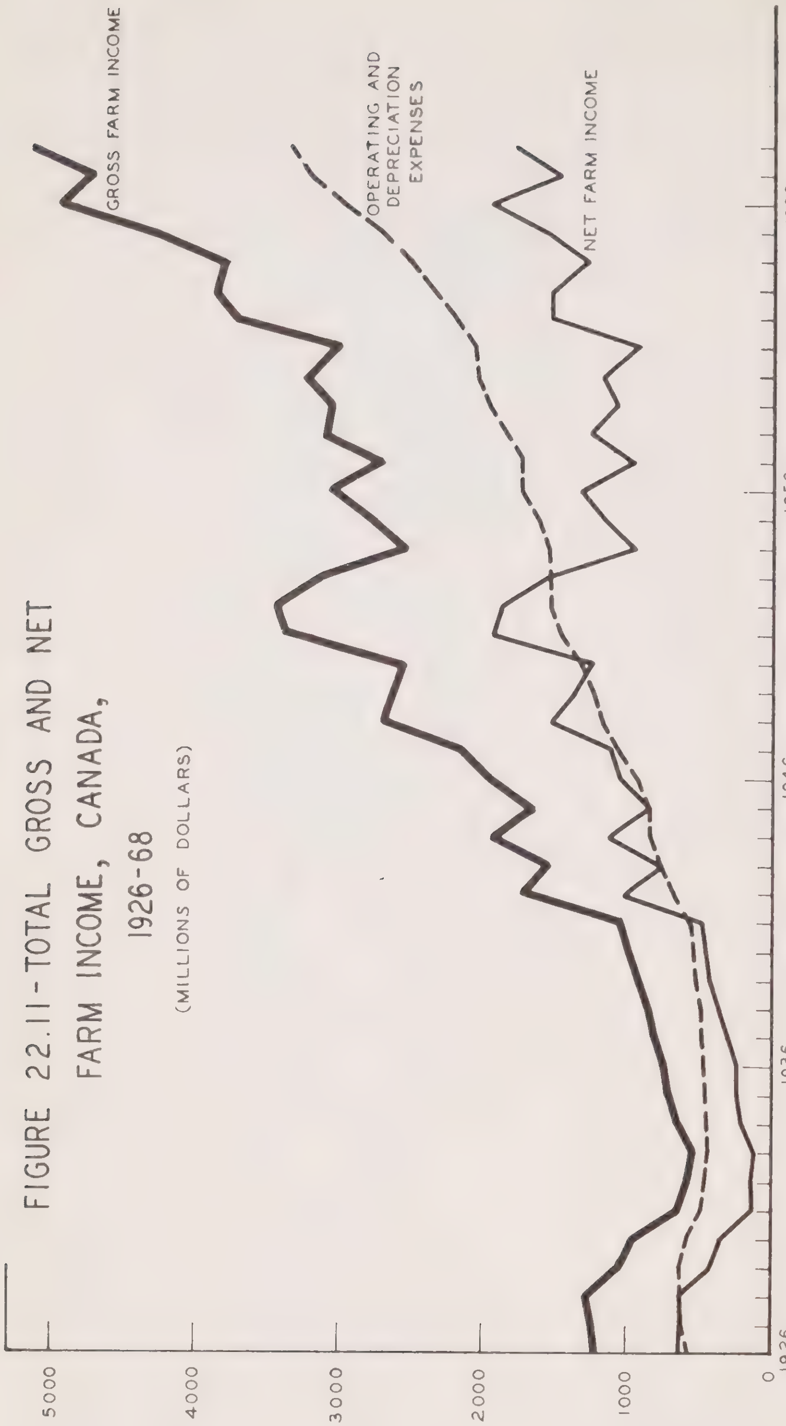
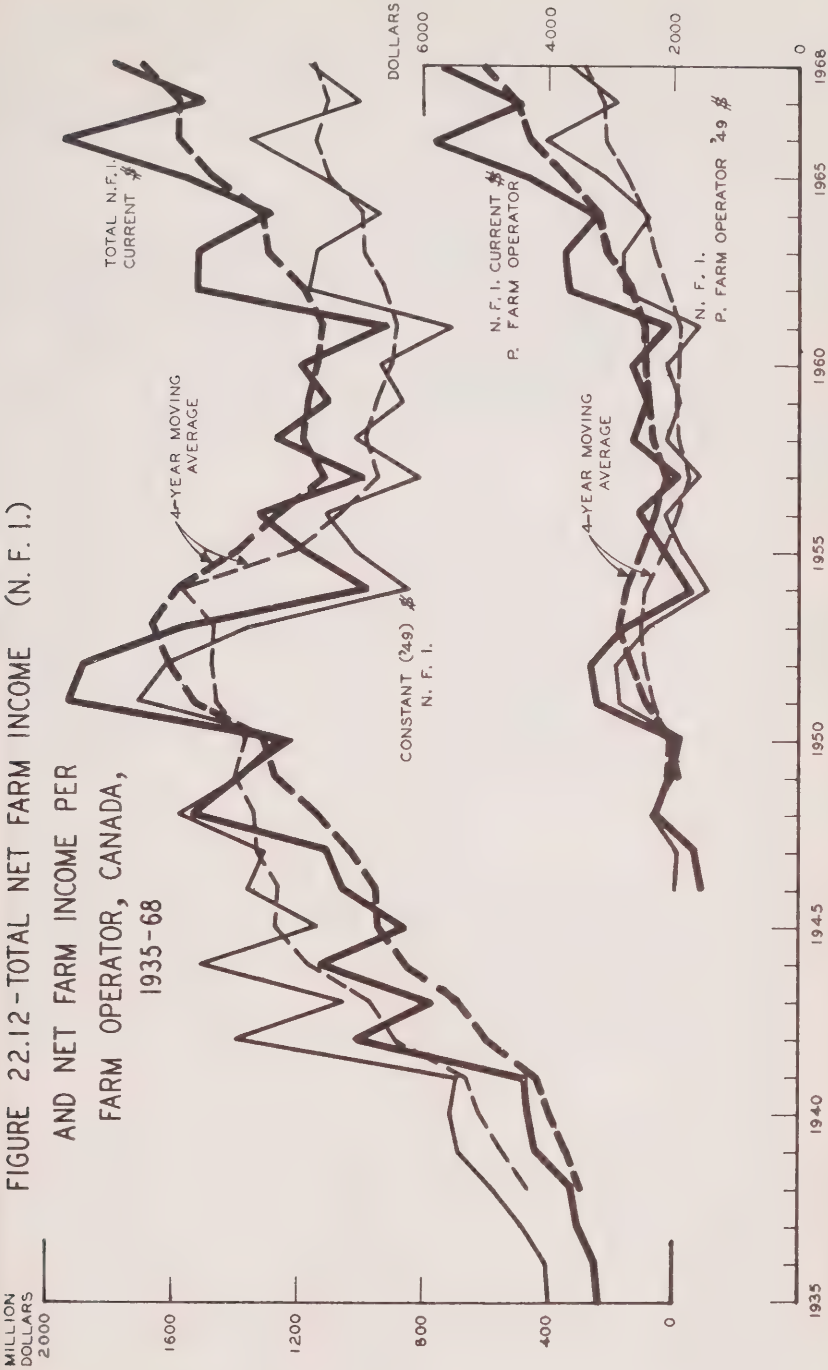


FIGURE 22.11 - TOTAL GROSS AND NET FARM INCOME, CANADA, 1926-68

(MILLIONS OF DOLLARS)

SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS SERIES PREPARED BY THE FARM INCOME SECTION OF THE AGRICULTURAL DIVISION, TAKING ACCOUNT OF ALL REVISIONS MADE TO SERIES UP TO AND INCLUDING THOSE RESULTING FROM THE 1961 AND 1966 CENSUS OF CANADA FOR AGRICULTURE; HANDBOOK OF AGRICULTURAL STATISTICS, PART II, FARM INCOME, CAT. NO. 21-511, AND FARM NET INCOME, 1968, CAT. NO. 21-202.

FIGURE 22.12 - TOTAL NET FARM INCOME (N. F. I.) AND NET FARM INCOME PER FARM OPERATOR, CANADA, 1935-68



SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, *HANDBOOK OF AGRICULTURAL STATISTICS*, *OP. CIT.*, *PRICES AND PRICE INDEXES*, *OP. CIT.*, *CANADIAN STATISTICAL REVIEW*, *OP. CIT.*, AND DATA FROM SPECIAL SURVEYS DIVISION OF DBS.

reveals the general rise in real total farm income after the Second World War to a level in 1951 which has not been regained since. However, because the number of farm operators to "share the cake" has declined, real net income per farm has shown an appreciable growth since its doldrums of the 1950s–though this does, of course, have to service the correspondingly larger stock of resources under the farmer's control.

Capital Structure – The capitalization of Canadian agriculture has now reached a substantial level, with total farm assets valued at $21.2 billion in 1967 compared with $1.8 billion in 1901. This does not imply that the physical capital stock has risen more than tenfold, for much of the observed growth in value (especially in recent years) can be explained by the rise in real estate values rather than new capital formation in any real sense. Rising prices for livestock and machinery also have inflated farm capital values. Nonetheless, considerable growth in the real capital stock has taken place.

The remarkable rise in farm real estate values, shown in Figure 22.13, has occurred in all provinces, and is a phenomenon of some note. The major contributing factors have been the growth in output per acre coupled with a favourable market situation for agricultural products, the demand for land for farm enlargement (and urban growth in some areas), expanded credit availability, the possibility of (untaxable) capital gains, and the desire for an asset to hold as a hedge against inflation. Coupled to these are a variety of traditional and sociological aspects of landholding which influence the real estate market. The mixture of advantages and disadvantages to the farmer resulting from the rise in land values is examined later.

Machinery Investment – Investment in machinery has reflected, above all, the changing fortunes of farming, falling during the depression and rising sharply with the post-1945 prosperity. From 1941 to 1951, the capital value of machinery on farms more than tripled with the rise in the numbers of tractors and combines. Despite the inflation in land values, the relative importance of real estate in the asset structure fell to below 60 per cent, while machinery capital rose to over 20 per cent of the total.

All provinces have shown the same cyclical growth path in machinery investment, the intensity of mechanization reflecting differences in the type of farming practised. The Prairies, although characterized by highly mechanized crop production, have a lower machinery investment per improved acre (see Figure 22.14) than Ontario and Quebec. Having smaller farms and more mixed production patterns, these provinces appear to utilize a higher level of capital per acre. This is clear in the case of Ontario, the southern regions of which engage in highly capitalized, intensive crop production.

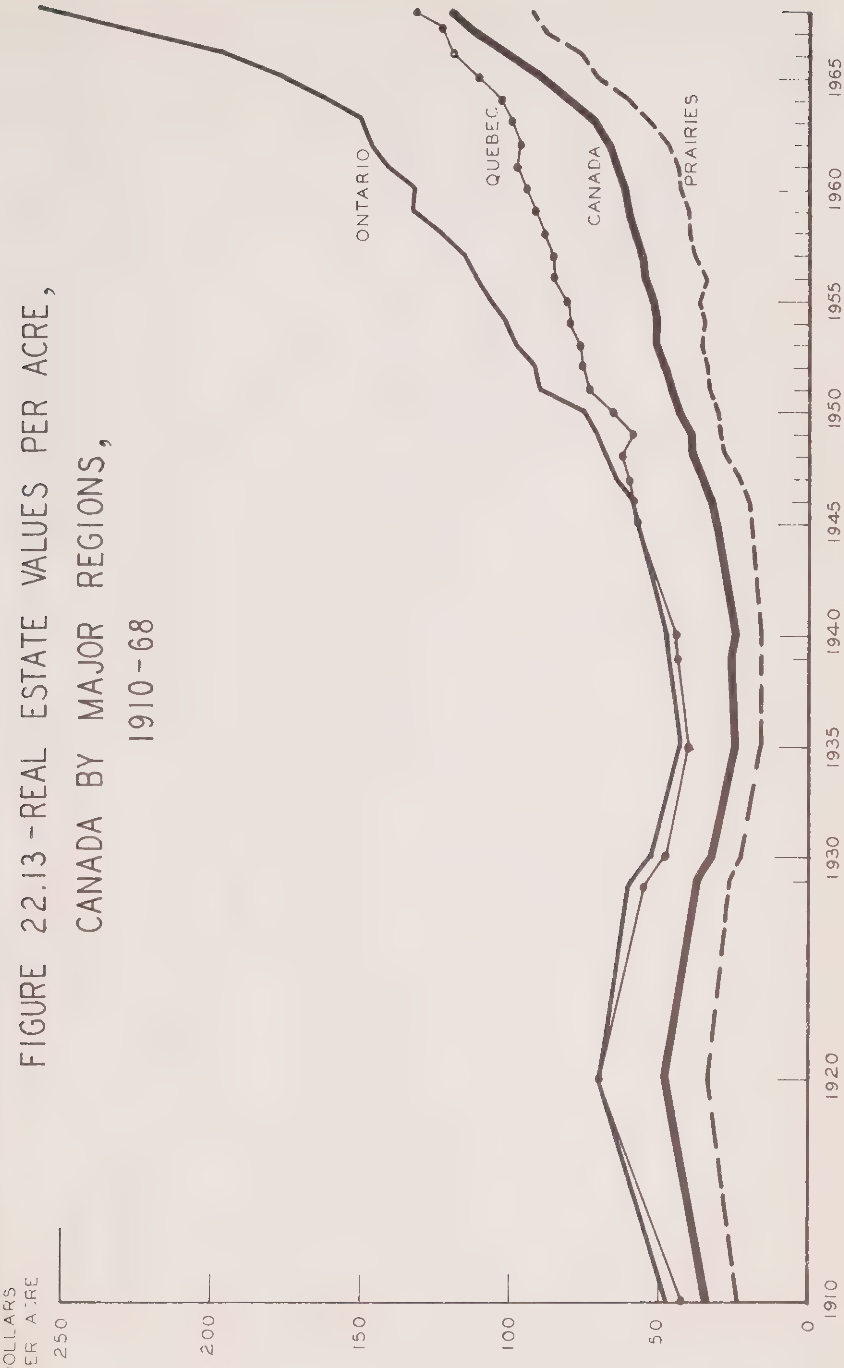


FIGURE 22.13 - REAL ESTATE VALUES PER ACRE, CANADA BY MAJOR REGIONS, 1910-68

SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, AGRICULTURAL DIVISION.

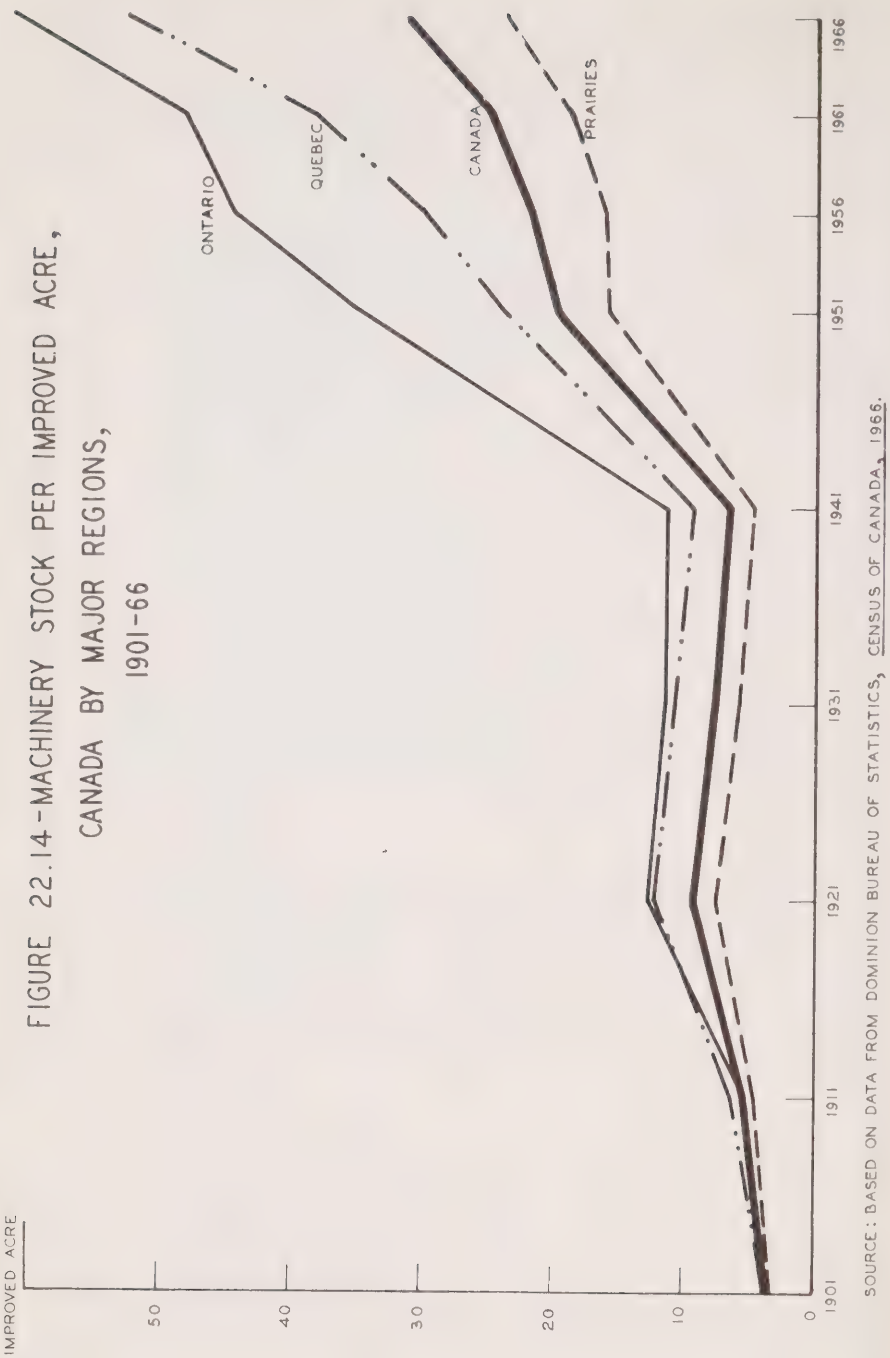


FIGURE 22.14–MACHINERY STOCK PER IMPROVED ACRE, CANADA BY MAJOR REGIONS, 1901–66

SOURCE: BASED ON DATA FROM DOMINION BUREAU OF STATISTICS, CENSUS OF CANADA, 1966.

TABLE 22.1–FARM MACHINERY IN CANADA, BY PROVINCES, 1966

Item	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Number of census-farms	26,393	80,294	109,887	194,844	19,085	430,522
Per cent with trucks or cars	78.7	80.0	91.6	93.4	88.0	89.3
Per cent with tractors	65.5	77.3	86.7	90.8	68.9	84.7
Per cent with combines	8.3	7.4	22.4	63.3	7.9	36.6
Per cent with swathers	0.6	3.6	4.1	55.7	4.6	27.2
Per cent with balers	23.6	30.4	34.3	32.2	19.3	31.3
Per cent with forage harvesters	1.6	4.5	9.9	3.4	7.5	5.4
Per cent with milking machines	23.3	47.3	34.9	9.1	14.2	23.9
Per cent with electricity	94.1	97.9	96.0	79.9	90.6	88.7

Source: Dominion Bureau of Statistics, *1966 Census of Canada, Agriculture* (Ottawa: Queen's Printer, June 1968), Table 21.

Chapter 23

DETERMINANTS OF THE GROWTH IN FARM MECHANIZATION

This chapter attempts to identify the dominant forces for change which have operated in the mechanization of Canadian agriculture. Both pressures which stimulate the growth of farm machinery use and those which might tend to restrain it will be identified.

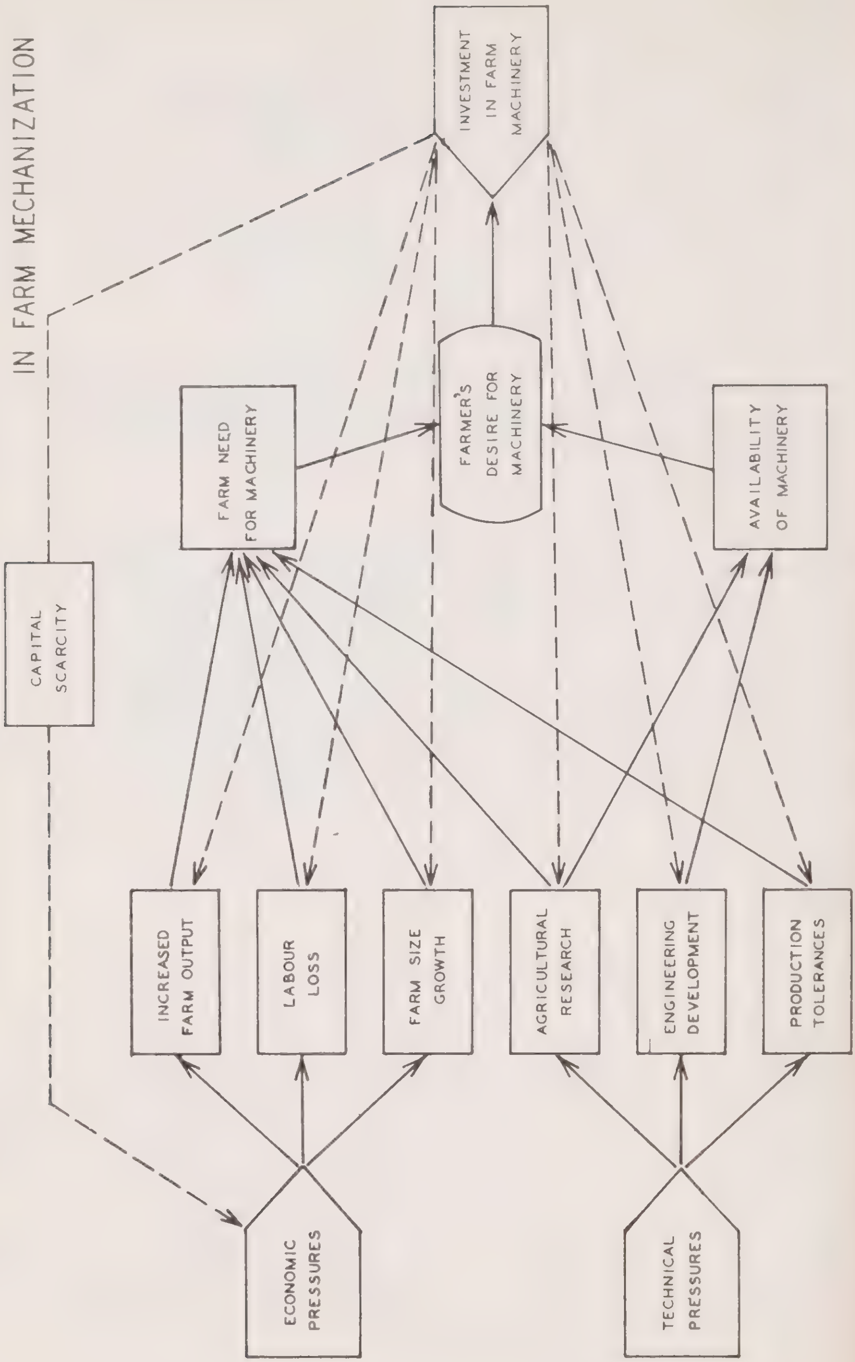
The forces that have led to the development of highly mechanized production in Canadian agriculture consist of a complex of technological, physical, economic and social factors which have perhaps operated separately at times, but usually in concert. Although the relative importance of each of these factors may have varied depending on the time, place, and type of mechanization considered, all have had some relevance to decisions on machinery use. It is largely impossible, therefore, to disentangle completely the farmer's decision process and attribute any particular aspect of mechanical innovation to a specific causal influence. The adoption of any new machine is merely the observed net result of all these influences.

The main elements of the farm mechanization process are depicted in Figure 23.1.

Technological Factors Influencing Farm Mechanization

Machine Technology – The development of machinery technology is the fundamental factor underlying the growth of mechanized production. Sometimes, the development of an implement may be enough to stimulate its adoption simply because it is so superior in use to any alternative. This was undoubtedly true of the moldboard plow and the row-spacing drill. Drawn by horses, they accomplished tasks that could not be as effectively handled by manpower alone. For innovations that perform new operations, or operations that were previously all but impossible, often the mere appearance of the machine provides a strong spur to its adoption. The same may well be true for new machines that are vastly superior to the traditional ones. Thus, the tractor heralded the demise of the work-horse and the combine superseded the binder and thresher.

FIGURE 23.1 - THE PROCESS OF CHANGE IN FARM MECHANIZATION



During recent decades, advances in farm machinery technology have led largely to major improvements and refinements in the basic farm machines, although some totally new machines have been developed too. Engineering and industrial research, most of it not specifically oriented towards agricultural machinery, has resulted in advances in all aspects of mechanical technology which have had important implications for farm machines. Based on these and their own developments, agricultural engineers have designed and offered to farmers a range of farm machinery with capabilities encompassing the whole spectrum of farming activities. Many of these satisfied needs that farmers had long recognized, while others offered facilities for which previously there had been no specific demand. Good examples of this are the refinements that have been added to the basic farm tractor. The modern farmer takes advantage of a reliable and efficient self-starting diesel engine, independent power take-off, three-point linkage and draft control, and the capabilities afforded by the tractor hydraulic system.

As well as having advancing mechanization "pushed" at him by the agricultural engineer, the farmer himself has exerted a "pull" on the machinery firms to develop the implements he requires to satisfy particular needs. The diskers now marketed by most machinery companies grew from the recognition by Prairie farmers of a need for a moisture-conserving alternative to the moldboard plow in large-scale cultivation of arable land. Similarly, the swather originated in a farmer's recognition of the need for a machine which would facilitate combining in areas with a short season. With the larger farms and more intensive production of modern agriculture, farmers are increasingly conscious of the difficulty of accomplishing cultivation and seeding operations within the critical time period. As a result, they have demanded more powerful tractors to pull wider implements–a demand that the manufacturers have shown themselves ready to satisfy.

Other Technology – Progress in the non-machinery technology of agricultural production has also been an important causal factor in the growth of farm mechanization. The benefits of research into fertilizers, herbicides, and pesticides could never have been exploited had not the appropriate machines for their application been developed by machinery companies, and adopted by farmers. The widespread use of fertilizer distributors and sprayers stems directly from these advances in agricultural chemistry. Other examples of agricultural research creating pressures for the development of a particular type of machine, and for its subsequent adoption by farmers, can be quoted: the breeding of monogerm seed in beet crops, the results of experiments into fertilizer placement in potato production, and the advent of ensilage for fodder conservation, have encouraged agricultural engineers to develop machines that could exploit these new production techniques.

The availability of a technological advance does not always imply an automatic and parallel growth in mechanization. The operation of increasingly complex machinery requires new skills on the part of the farm labour force, and the maintenance of these machines demands technical competence and facilities of a

high order. Where these skills and facilities are not available, or grow at a slower rate than the availability of sophisticated machinery, their absence acts as a brake on the rapid or widespread adoption of advanced mechanization. The immediate take-up of new machinery has in some instances been impeded by machines being marketed before they were fully tested or appropriately tailored to their intended task. In addition, farmers' lack of information concerning the capabilities and reliability of a new machine acts as a deterrent to its use, thus causing a lag to arise between the introduction and subsequent general adoption of new machine technology.

Despite this, however, it is clear that technological developments themselves have provided an important element in the pressure towards mechanized farming methods. This implies a great tribute to the ingenuity, skill, and inventiveness of farmers and engineers.

Production Risks – Another factor that has spurred the adoption of farm machinery arises from the increasing level of risk confronting the farmer, and the potential ability of machinery to reduce, or in some cases largely eliminate, some of these risks. With the growing commercialization of agriculture, higher yield levels, and larger holdings, the individual farmer is handling a greater value of output each year. Given the vagaries of the weather and the uncertainties inherent in a biological production process, the farm's production represents many thousands of dollars which are virtually under constant risk right up to the time the output is harvested. In many ways the modern farmer can look to his machinery to provide an important measure of insurance against output uncertainties.

For example, the level of yield for many crops is largely dependent on seedbed preparation and planting being completed by an early date in spring. When weather delays these operations, the available time for the task may be very short if planting is to be achieved at the optimal time. The larger acreages under each farmer's control worsen this problem, leaving him little alternative but to mechanize his operations and utilize large-capacity machines to attain the necessary rate of work. Even if planting is completed in time, the full growth potential of the crop subsequently requires an adequate level of fertilization, spraying, and weeding–operations which rely on a high level of machinery use. Similarly, the level of harvested yield is dependent on harvesting being accomplished within a short and very critical period after ripening, or losses from shelling and spoilage can radically reduce profits. The short time available for harvesting, and further uncertainty surrounding the availability of suitable operating conditions within this period, induce farmers to acquire an ample machinery capacity to ensure that the crop can be gathered with reasonable certainty.

In livestock production, too, there are many instances where the effort to reduce variability in output leads towards mechanized production methods. In dairying, an early example was the milk cooler, which minimized the risks in milk storage. Currently, the newer forage equipment such as the hay conditioner and the

forage harvester are being adopted to bring more certainty into the production of good quality conserved fodder.

In many other ways, the susceptibility of farm output to the uncertainties of weather has led the farmer to look to mechanization for some insulation from its effects. Thus investment in grain-drying facilities can compensate partly for wet harvest conditions, and the installation of irrigation equipment can provide some insurance against drought. As in all cases of insurance, however, the reduced uncertainty only comes at an additional cost. But, with the narrowing of profit margins and the large amount of capital at risk, levelling out fluctuations in output becomes a consideration of major significance.

Physical Factors Influencing Farm Mechanization

Labour Loss – The growth of farm mechanization and the reduction in the agricultural labour force have been clearly associated during recent decades. While the number of persons employed in agriculture has halved since 1946, the stock of machinery on Canadian farms has almost doubled in constant dollars over the same period. On empirical as well as logical grounds, therefore, it is not unreasonable to look on labour loss as an important factor in the process of mechanization, both on the individual farm and in agriculture as a whole. The direction of causality between these changes is not immediately obvious, however. Has the loss of agricultural labour forced farmers to mechanize, or have workers been forced out because farmers found it advantageous to replace them by machines? Probably both types of pressure have been operating.

Although it is impossible to specify the number of farm workers who leave agriculture of their own free will, it is clear that voluntary out-migration is an important element in labour loss. Studies have shown that the "pull" of higher off-farm earnings is a significant factor in attracting workers away from the land.[1] The family labour component of the aggregate farm labour force also tends to decline as the tendency towards longer education makes farm children unavailable for work on the family holding; further, it changes their outlook, and many of them look elsewhere for employment.

Over time, the steady flow of labour into the non-agricultural sector, whatever its cause, means that an important input in the production process has been lost. If output is to be maintained, some alternative must be found. Fortunately, the possibility of utilizing machines to do the work formerly done by man has been increasingly open to the farmer. He has been able to substitute for the lost manpower, by investing in more and larger machines, so avoiding reduction in output. Part of the decreased labour input has been offset, too, by the exploitation of advances in non-machinery technology, in the form of improved seed varieties, fertilizers, chemicals, and better production practices.

[1] K.G. Cowling and D. Metcalf, "Labour Transfer from Agriculture: A Regional Analysis", *The Manchester School*, Vol. 36, No. 1, March 1968, pp. 27-48.

The extent to which a shortage of labour will induce further mechanization will depend on a variety of factors, particularly the type of farming and the products produced. This is because machinery is not a perfect substitute for labour in all cases. Some machines, such as the complete potato harvester, the side rake, or the milking machine, can be regarded very largely as a direct substitute for labour use. Other forms of mechanization may either augment the efforts of human labour or perform operations that were not previously attempted since they were not feasible using manpower alone; the plow, the hammer-mill, and the grain-dryer fall into this class. Other machines, especially the more recent ones, combine into one unit the operations previously conducted by several machines and thus substitute for the older types of machinery as well as for labour. The combine harvester and the potato planter are good examples of this latter type. Many machines currently available to the farmer will have all three of the above characteristics, and as a result it is virtually impossible to attribute a proportion of the observed growth in farm mechanization specifically to the reduction in labour use. On the individual farm the impact of labour loss on further mechanization will depend also upon the size of the farm, the remaining labour force, the level of mechanization already achieved and the available capacity that can be exploited.

In summary, it is unlikely that agriculture could have withstood the dramatic decline in its labour force had it not been able to compensate by increased mechanization; conversely, it is questionable whether mechanization would have reached its present level were it not for the presssures of labour loss.

Output Expansion – Agricultural production has not only been maintained in the face of a declining labour input, but has actually shown a steady increase over the past decades. From 1942 to 1967 the physical volume of output from Canadian farms rose on average by slightly over 2 per cent per year. This expansion in output itself has given rise to pressures for further mechanization, in order that the growing volume of farm production could be handled. Similar pressures were exerted in the earlier years of this century when Canadian agriculture was experiencing its "expansion phase". As the area of settled improved land in farms grew, agriculture required a growth in both its labour force and associated machinery in order to cope with the expanding production base. Now, even with a declining labour force, the expansion in farm output has been maintained, and so too has the need for increased machinery capacity to handle it. Thus, even if the size of the labour force had remained constant, the observed growth in output alone over the past 30 years would have been sufficient to explain a significant part of the growth in farm machinery use.

Farm Enlargement – The amalgamation of holdings and the increase in average farm size is closely associated with the decline in the labour force, and has important implications as a determinant of mechanization. The very fact of amalgamating two holdings implies that one complete farm family leaves the land–that is, the agricultural labour force loses a farm operator and his associated family labour (unless they transfer to the hired labour force). From the standpoint

of the agricultural industry, therefore, its labour input has declined and potentially will require replacement by alternative inputs. In any individual case it may happen that the amalgamating farmer already had the necessary machinery capacity to handle the additional acres; indeed this may well have been a factor that encouraged him to acquire more land. Over time and for the industry as a whole, however, this cannot usually be the case. Thus, as some farmers react to economic pressures by leaving agriculture, and others by enlarging their farms, a basic stimulus is created for an increased investment in machinery capacity and other complementary inputs. Farm amalgamation may further spur machinery investment by inducing the farmer to reorganize and rationalize his whole production structure and method of farming in order to exploit any cost economies obtainable from larger scale mechanized production.

Economic Factors in the Growth of Mechanization

Advances in machinery technology have been basically permissive factors in the growth of mechanization: continued labour loss, larger farm sizes and higher risk levels have created a potential need for expanding machinery use. But the actual growth in mechanical equipment on farms has only come about because finally the net weight of economic considerations has been favourable to this investment. Thus, given the availability of machines and a useful place for them in the farming system, farmers have been able to increase profits or offset losses by their adoption, and have been able to acquire the necessary capital in order to exploit these gains. While the initial cost of machinery investment is high, the cost of *not* mechanizing has been even higher in terms of economic opportunities forgone.

Labour Replacement – When labour leaves the farm, it need not be replaced by machines, for agricultural output could be allowed to fall as the labour input declined, or it could be maintained by resort to expanded use of non-machinery inputs. In fact, studies have shown that there has been a strong economic justification for using machinery inputs in the place of labour. Econometric analyses of farming in Manitoba suggest, that, at 1966 prices, one dollar invested in machinery expenses could substitute for between $1.20 and $1.50 spent on labour–thus resulting in the same level of output at reduced cost.[2] Consequently, farmers could not only compensate for lost labour but had some economic incentive to actively encourage a reduction in their labour force and replace it by machinery services.

On the other hand, while this indicates that the substitution of machinery for labour is profitable from the industry's standpoint, the strength of this as a determinant at the farm level is less explicit. Much of the decline in the work force has been in the family labour component which does not have an appropriate wage

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[2] A.W. Wood, T.D. Harris, J.P. Hudson and F. Tennenhouse, *Effect of Changes in Farm Machinery on Cost and Productivity of Prairie Agriculture, 1945-1966,* unpublished Commission study, 1968.

rate for comparison with machinery productivity. Furthermore, where the decline has comprised farm operators quitting production, this does not represent a conscious farmer decision to substitute machinery for labour–though this may be the final effect.

Machinery Economies - The possibility of per unit cost reductions from larger scale mechanized operations provides an economic basis for the amalgamation of holdings and the move towards larger farming units. Conversely, the autonomous growth in the size of farms actually requires a shift towards machinery-based production for economic as well as for physical reasons.

The analysis of Manitoba farms for 1966 indicated that the return from one extra dollar spent on machinery services, with all other inputs held at a constant level, was about $1.50. This was higher than the return that could be achieved from a dollar spent on any other input except fertilizer. An earlier Manitoba study[3] suggested that the rate of return on further capital invested in farm machinery was of the order of 25 per cent, while studies in the United States[4] have estimated the marginal return on machinery capital at between 15 and 30 per cent. These are, however, average figures relevant to the group of farms studied; any individual farmer is not necessarily able to achieve gains of this order. Furthermore, since he cannot invest in marginal units of one dollar, the profitability of investing several thousand dollars in an additional machine may sometimes be negative. It is clear, however, that regardless of the desirability of increasing mechanization to counteract labour loss or increased farm size, much investment is justified on economic grounds alone. The contribution to productivity of farm equipment makes it a profitable area for farmers to invest capital–if they have it, or can acquire it. The Manitoba study suggested that machinery inputs could rise by as much as 50 per cent and still cover their costs.

Cost-Price Pressures – The underlying economic incentive to substitute machinery for labour, and to utilize relatively more machinery when expanding output, arises from changes in the relative prices received for farm products and paid for various inputs. During the Second World War, the subsequent world food shortage, and then the Korean War, the index of prices received for agricultural products rose rapidly and remained well above the index of prices of commodities and services

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[3]J.C. Gilson and M.H. Yeh, *Productivity of Farm Resources in the Carman Area of Manitoba,* Department of Agricultural Economics, University of Manitoba, Bulletin No. 1, Winnipeg, 1959.

[4]E.O. Heady, *Productivity and Income of Labour and Capital on Marshall Silt Loam Farms in Relation to Conservation Farming,* Agricultural Experiment Station, Iowa State College, Research Bulletin No. 401, Ames, Iowa, 1953.
E.O. Heady, *Resource Productivity and Returns on 160-acre Farms in North-Central Iowa,* Agricultural Experiment Station, Iowa State College, Research Bulletin No. 412, Ames, Iowa, 1954.
E.O. Heady and R. Shaw, *Resource Returns and Productivity Coefficients in Selected Farming Areas of Iowa, Montana, and Alabama,* Agricultural Experiment Station, Iowa State College, Research Bulletin No. 425, Ames, Iowa, 1955.
E.O. Heady and E.R. Swanson, *Resource Productivity in Iowa Farming,* Agricultural Experiment Station, Iowa State College, Research Bulletin No. 388, Ames, Iowa, 1952.

used by farmers, with both indexes on a 1935-39 base (see Figure 23.2). This more favourable cost-price ratio encouraged an expansion in farm output, and, as the figures quoted earlier indicate, an increased farm machinery input was a profitable means of achieving this. In addition, the relatively high incomes earned provided a useful source of funds for machinery investment. After 1951, however, the level of agricultural prices started to fall from its high point, while input prices continued to rise. By the mid-fifties, the product price index had started to rise again, keeping pace for a while with the increasing input prices. In 1961, farm product prices faltered again, and have since been inflating more slowly than costs. Thus, since the early fifties, there has been an increasing "cost-price squeeze" operating on the farmer, creating a pressing need to improve agricultural productivity in order to maintain adequate farm incomes.

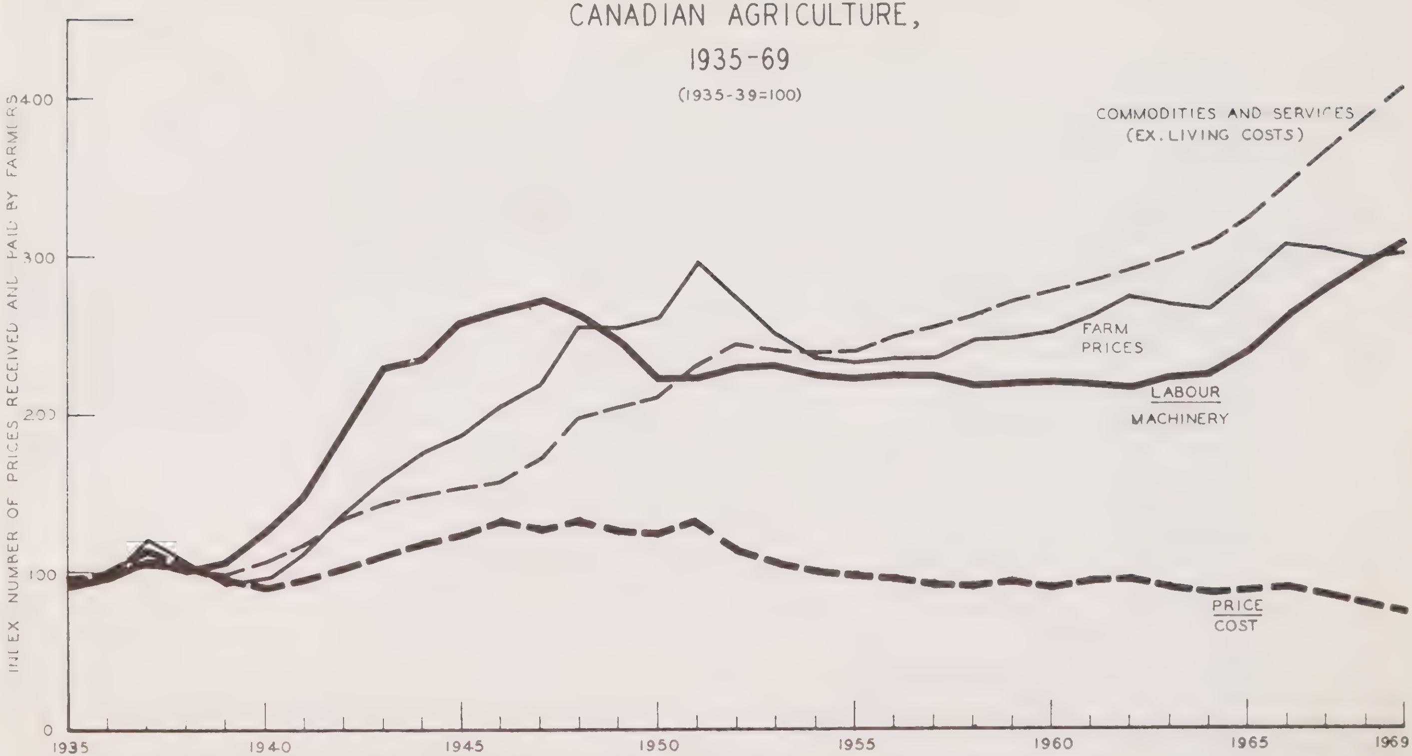
Productivity can be increased by high-cost inputs being replaced by lower-cost inputs, or substituting high-productivity production factors for low-productivity ones. Much of the economic incentive to replace labour by machinery has arisen from this source. Although the price indexes of both these inputs have risen since 1935, the index of wage rates grew much faster than that of machinery prices until 1947. During this period the ratio of farm wage rates to machinery prices rose from an index of 100 in 1935-39 to 270 by 1947, indicating a strong pressure to reduce costs by substituting machinery for labour. Since 1950, however, both indexes have increased at virtually the same rate, so on the basis of price levels alone there has been no distinct advantage in substituting machines for men. But price indexes may not measure fully the economic difference between the inputs—their productivity per unit cost. The contribution of $1 worth of machinery to farm output has been greater than that of $1 spent on labour (as the Manitoba figures show), and for this reason farmers have found it advantageous to combat the cost-price pressures by shifting to higher levels of mechanized production.

With narrowing per unit profit margins, higher levels of output are necessary to provide an adequate aggregate farm income, and for the individual farmer, this in turn implies intensifying production or expanding the acreage farmed, or both. With an increasing scale of operation, about the only means available to the farmer for cultivating more acres, and handling the growing output levels, has been to achieve a high level of mechanization. Furthermore, the pressure on prices (both domestically and internationally) and costs has resulted in a need for a consistently high and uniform quality of product—whether it be the final output such as grain, or a farm-produced input such as fodder. This can only be ensured on large acreages by utilizing a full complement of equipment to accomplish the necessary growing and harvesting operations within the limited and critical time periods available. All this has led to a growing investment in farm machinery.

Unlike fertilizer, which can be purchased as it is needed, the acquisition of new machinery represents an investment of a medium-term nature. In production economics terminology, it is a flow input; its stock of services is purchased in advance and is given off more or less uniformly over time. These services cannot be

FIGURE 23.2-PRICE-COST RELATIONSHIPS, CANADIAN AGRICULTURE, 1935-69

(1935-39=100)



SOURCE: BASED ON DATA TAKEN FROM HISTORICAL STATISTICS OF CANADA, THE MACMILLAN COMPANY OF CANADA LTD., 1965; SELECTED STATISTICAL INFORMATION ON AGRICULTURE IN CANADA, OCTOBER 1969, AND CANADIAN FARM ECONOMICS, APRIL 1970, CANADA DEPARTMENT OF AGRICULTURE.

stored for future use if not exploited at any given point in time (if a combine's harvesting capacity is not used in August these same services are not available for use in December, nor even the following August); thus the value of the investment depreciates over time, whether it is used or not. Furthermore, the investment requires additional expenditure (in the form of repairs and maintenance) in order to ensure that the full potential stream of services is gained.

Thus, although machinery may readily substitute for labour in a functional sense, and may be economically justified in terms of lowered annual production costs in the future, the immediate economic effect on the farmer may make the investment less obvious. To take a very simple example, investing $16,000 in machinery with a life of eight years may enable him to reduce his labour force by one man earning $3,200 annually. In one sense this represents a cost saving of $9,600 over eight years. In another sense, however, he is effectively having to find five years' wages in advance in order to acquire the machine.[5] This means substituting a lump-sum cost at one point in time for a very much smaller flow cost which could be paid out of the income that is generated on the farm during the succeeding years. The difficulty of acquiring this necessary initial capital sum may deter the farmer from making the investment.

Farm Income Level – The availability of capital for medium-term investment is an important determinant of farm mechanization. For some farmers, current or accumulated profits may provide a ready source of funds and such "plowing back" of profits can often finance a significant part of a farmer's purchases of new machinery. This is particularly true where farmers trade in major equipment items every year or two so that the net payment required each year is small. In addition, the amounts charged to depreciation of machinery are an important source of finance over time. For the twenty-year period from 1949-69, depreciation against machinery amounted to around 90 per cent of the value of new machinery purchases.

Nevertheless, for new entrants and for farmers who are expanding their operations in a major way, the availability of capital may still be a major constraint. Net income per farmer remained fairly static throughout the late fifties and if this series is divided by the price of farm machinery, the purchasing power of the farm operator's income for machinery has declined continuously since the end of the Second World War.

The problem of capital availability for mechanization has been aggravated by the fact that land and machinery are, in a sense, complementary inputs. Pressure to mechanize production and to increase farm size often go hand in hand. So, with land and machinery being competitive in their demands for already scarce farm capital, and the pressure to increase farm size being perhaps stronger than the

[5] This simple comparison disregards operating and repair costs on the machine. In addition, of course, discounting procedures should be used to obtain the more valid comparison. If the savings on future wage costs are discounted at an annual rate of 7 per cent, however, the savings from machine investment still amount to $3,133 over eight years.

pressure to mechanize further, it may often become increasingly difficult to find the funds essential for machinery purchase as capital is committed to the acquisition of land. Both credit availability and taxation policy affect agriculture's ability to acquire new farm machinery. However, the impact here is mainly at the individual farm level and will be discussed in some detail in Chapter 25.

Social Factors Influencing Farm Mechanization

Farmers' Attitudes – Some of the attitudes that can influence the process of farm mechanization may be a reflection of the fundamental values of society. Great stock is often placed on individual achievement and on the material gains that are considered to be the reward for hard work. Since the possession of farm machinery is one visible means by which status or achievement can be judged, the acquisition of farm machinery may have a competitive element. Mechanical equipment may be a symbol by which status is indicated—just as size of land holding and numbers of livestock have been in older and less-developed communities. Still, given the evidence that investment is profitable in any case, there is no clear evidence that prestige factors alone are important.

Over time, attitudes to machinery have changed. Machinery has become widely accepted as a major part of farming, and one that is attractive to many farm people. Extension personnel have observed that the presence of machines is often the one thing that is effective in persuading young men to stay on farms. Whether there is some psychological satisfaction in the noise and motion of a big machine, or some pleasure in seeing a good job well done, does not seem to have been explored. On the other hand, it is certainly true that all kinds of farm machinery are not only accepted but relied upon. When tractors first became widespread in the 1930s, they were on trial. Although the number of tractors increased at that time, the number of horses did not begin to decline rapidly until almost a decade later. Little of the same caution is evident in more recent times. Once a machine is shown useful and effective it is usually introduced as soon as economic pressures permit.

On the other hand, the recognition that increased mechanization is associated with changes in the way of doing things, and with the passing of a familiar mode of life, can lead to an adverse reaction to machines. The fact that increased mechanization leads to the movement of people out of farming may cause some resentment to be felt toward it. Since the rural-to-urban transfer causes many stresses both in those who leave and those who stay, the social connotation of expanding mechanization may not be a pleasant one. When it is remembered, too, that machines can have injurious physical and health effects, it is not surprising that the reaction in some cases might be one of distrust. To the extent that this feeling does exist, it must tend to work against the increase of mechanization.

External Influences - A positive attitude to machines and equipment is fostered by the imagery and ethics of the modern world of science and technology. Thus, the present-day farmer can identify—in terms of his tools, equipment, and expertise—with those involved in the construction, manufacturing, and transport

industries, and all have given a ready acceptance to technology which involves a commitment to continuing change.

Part of this new imagery is the acceptance as a "norm" of an urban standard and mode of life. Consequently there seems to have developed an increased leisure preference among farmers, together with an expanding demand for domestic capital goods to take some of the drudgery out of farming. An example might be seen in the expansion of materials-handling equipment on farms. The greater demand for household consumer durables, on the other hand, by competing for scarce capital, might operate as an opposing force.

Risk Effects – Other pressures operate to resist or slow the rate of mechanization. On the management side, new technology often requires new knowledge. The learning process takes time and effort, and a shortage of either may impede the progress of mechanization. In the same way, new machinery may require new operating and maintenance skills and these, too, have to be developed. Where the farmer is an owner-operator, this means that competence has to be developed in two separate areas before a mechanical innovation can be fully exploited. Though the acquisition of this ability can be facilitated by formal training, the shortage of training facilities may be a limiting factor.

Uncertainty may also place a real restraint on innovation. Confronted with a new situation, the farmer's reaction may be simply one of fear of the unknown. In addition, the fear of not being successful in the adoption of a new technique can provide a strong disincentive for innovation. Alternatively, if mechanization is considered desirable, the possibility of failure associated with not adopting the new technology may have an offsetting effect.

A similar restraint on the progress of farm mechanization may be imposed where capital investment is required. Often medium-term credit has to be used for the acquisition of new machinery and there may be an unfavourable attitude to the use of this type of credit. To some extent this is a holdover from unfortunate experiences of the 1930s. To an even greater extent it is a reflection of the strong values held concerning sovereignty of the individual, and particularly of the authority and freedom of action which it is considered are lessened or lost by being in debt. A Commission study has shown that the main concern of farmers with regard to credit is not the amount available, but the terms and conditions on which it is available.[6] The same study revealed that many farmers felt that credit was too readily available. In so far as these attitudes reflect a reluctance to use credit where it is profitable to do so, they are likely also to inhibit the growth of farm mechanization.

Such attitudes may have their basis in the risk considerations associated with borrowed capital and its effect on equity. Uncertainty can be directly related to the

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[6] A. Segall, *Farmers' Attitudes to Farm Machinery Purchases*, Royal Commission on Farm Machinery, Study No. 4 (Ottawa: Queen's Printer, 1969).

size of investment, in that the potential loss is greater for a larger investment as is the possible gain. In general the cost of a decision error is higher. But the risk involved in investment may be increased by changing equity proportions. As the amount of capital borrowed increases so do the charges related to it. These costs are fixed, in so far as they are not related to seasons or farm output. Consequently, as the proportion of borrowed capital rises the fixed costs increase directly and the possibility of a loss is heightened. In other words, increasing risk accompanies decreases in equity. Since bankruptcies are irretrievable, the spectre of vanishing equity haunts small farmers and businessmen alike, and more so in situations where output is uncertain. For many, the effect may be a deterrent to investment and so to increased mechanization. In spite of such negative pressures, however, the mechanization of agriculture has proceeded apace.

Chapter 24

IMPACT OF MECHANIZATION ON AGRICULTURE

What has been the impact of mechanization on the nature of agricultural production, on its levels of input and output, and on the rural environment as a whole? What benefits have accrued to the Canadian economy, and the agricultural sector in particular, and what have been the costs? This chapter will review the mechanization process in terms of its effects in the wider context of the agricultural industry. The following chapter will discuss in more depth the adjustment problems created at the individual farm level by a highly mechanized production structure.

Impact on the Technology of Farm Production

In Chapter 21 it was concluded that technological advance can ultimately be viewed simply as the availability of new or better inputs in the production process. This definition applies to all new technology, whether in the form of innovations (that is, distinctly new inputs or production techniques) or merely improvements in the quality of existing ones. In so far as farm mechanization has been an expression of technological change, it will be reflected as a shift in the input structure and hence an alteration in the technology of agricultural production.

More specifically, the rapid growth in the use of machinery on Canadian farms in recent decades has meant that: (a) a variety of new inputs, in the form of mechanical innovations, have been applied to agricultural production; (b) with continuing advances in machinery technology there has been a progressive improvement in the quality of these machinery inputs; (c) along with the new equipment have grown improved production practices and methods of utilizing the traditional inputs; (d) the rise in the absolute importance of machinery inputs, and their substitution for other types of productive resources, has materially altered the proportions in which the different farm inputs are used.

Individually, each of these four effects implies a modification of production techniques; collectively they amount to a radical transformation in the technology of Canadian farming. As a result, agriculture has taken on many of the characteristics of an industrial production process with a strong orientation towards the exploitation of mechanical power.

Power Inputs – Foremost in the development towards "power farming", both in terms of importance and the time sequence, was the emergence of the tractor as the basic power unit and its rapid and widespread adoption. Having been released from the constraints imposed by the speed, power capacity and stamina of the farm horse a whole new approach to farm operations was open to the farmer. Even in the early days when the tractor was little more than an engine on wheels, the new possibilities were extensive. No longer was the size of the job and rate of work tied to that of a horse team. No longer was the length of the working day determined by the stamina of the horse, but rather by that of the operator. This potential lengthening of the working day (coupled with the reduction in time spent tending horses) and the increase in the speed of operation had far-reaching implications for farm work.

A further step towards increased power use came as the supply of electricity spread into rural areas. The electrification of the farmstead, as well as providing domestic benefits, enabled many of the daily farm chores to be more rapidly and effectively accomplished. This alone resulted in substantial savings of time and effort, and greatly improved the efficiency of many localized operations. Although in its early stages as yet, the widespread availability of electric power promises a new era in the mechanization of livestock production.

New Machinery Inputs – The appearance of the tractor as the basic farm power source provided the spur for further changes in the technology of agricultural production. As it was refined and developed into a versatile unit with a high capacity and reliability, a new generation of equipment evolved around the tractor to exploit its capabilities. On the one hand, this meant larger implements (and the feasibility of larger implements has in turn led to a demand for even larger tractors). But it has also fostered a new breed of machines, dependent not on the draught power of the tractor unit but on its stationary power output via the power take-off and hydraulic system. By this means the tractor has become a mobile power unit which can be coupled to a wide variety of equipment that was formerly not available, or at best had to be self-propelled or ground-driven.

New Operations – A new range of machines has enabled a whole new set of operations that were previously either impossible (such as hay-baling, feed milling or rotary cultivating) or could not be easily and effectively accomplished by traditional methods. Subsoil plowing, land drainage and all forms of loading and lifting are operations greatly facilitated by mechanization. Coupled with this, the ease of operation afforded by the three-point linkage and hydraulic lifting of implements, plus the precision of automatic draft control have allowed major advantages in cultivation work.

The farm tractor developed not only in sophistication and refinement but also in size and power rating. The advent of the rugged crawler tractor made the task of land reclamation and improvement far more feasible, and much of the more recent expansion in the total farmland area and improved acreage in Canada stems from this development.

The net result of the adoption of these new and continually improving machines, and the new farm activities they engendered, has been to transform farming as a productive process. From an occupation conventionally characterized by the steady plodding of a cart-horse, and whose pace and sequence were almost totally governed by climatic and biological considerations, farming can now claim to have changed its image. The modern farmer controls an almost industrial process, utilizing large sources of mechanical power and machinery for accomplishing operations with speed and a large measure of independence of climatic phenomena.

Labour Inputs – The primary impact of mechanization has been to adjust the technology of production towards a power- and machine-oriented process. This is reflected in a complete change in the whole input structure of farming. Concomitant with the expansion in machinery use has been an increase in such associated inputs as fuel oils, lubricants, tires, baler twine, and in accessory power inputs–notably electricity.

In contrast, the labour input in farming has declined markedly in quantitative importance, both in absolute terms and in relation to the level of output. This reduction in labour use is reflected in the fact that in 1966 one man's labour was applied to 200 improved acres. This compares with one man per 70 improved acres in 1921 and per 43 improved acres in 1901. Mechanization has thus allowed agriculture to accept a steadily declining labour force without suffering any contraction in the size of the industry.

On the other hand, the quality of the farm labour force has greatly improved. The farm worker must now possess a wide range of machine-operating skills and a high level of technical awareness if he is to use effectively the equipment under his control. He has almost become an indispensable accessory to the machine rather than a primary input in production.

Input Mix – Table 24.4 below shows how the mix of inputs used in Canadian farming has changed over the past few decades. The decline in labour input is evident, while machinery use, fertilizers and purchased feed have all shown significant expansion as farming technology has changed. Much of the growth of purchased feed can be explained by an increasing specialization within agriculture, with less of the livestock feed being transferred within a farm but sold instead through the market for use on other farms.

As well as bringing to agriculture new inputs directly associated with machinery use (such as fuels and oils), mechanization has had an impact on the introduction of other new resources. Thus the rise in inputs of fertilizers, of herbicide and pesticide chemicals has, of necessity, been closely associated with the increased use of farm machinery. With the advent of the hammer-mill, farm-produced and -prepared feeds became a major new input in livestock production. Barn-dried hay and dried grass are further new products (and new inputs) which were only made available by the advances in machine technology.

Further changes in the technology of farming have taken the form of new methods of applying inputs and improved techniques of production. In crop production, an array of new methods have been based on machinery innovations. An early example was the combined cutting and threshing of grain via the combine harvester; or similarly, the combine drill which allowed fertilizer to be more effectively used by placing it, simultaneously with the seeding operation, in the root zone. There were also developments in mulch tillage to control wind erosion and more effective disease and weed control in the growing crop through the practice of spraying. Alternatively, the exact placement of fertilizer and the ability to handle germinated seed in the planting operation can be cited as greatly improved techniques of potato production emanating from the introduction of the appropriate machines.

Many advances in the techniques of livestock production and fodder conservation stem almost entirely from developments in machinery technology. Hay conditioners promote rapid drying, balers enable faster and more convenient handling of hay, forage harvesters and self-unloading trailers speed silage making and make possible the technique of zero grazing. A variety of highly intensive systems of livestock production, from broilers to beef cattle, have been developed using buildings and machinery fully integrated to permit virtually automated production methods.

In general, the progressive advances in machinery technology and its ready availability to the Canadian farmer have been significant factors both in exploiting new ideas on farm production methods and in initiating a modification of traditional techniques.

Mechanization has also improved the work capacity on farms and the rate at which essential tasks can be completed. Much of this result derives from the growth in the use of the tractor as the basic farm power unit. The ability to go faster, both when pulling implements or travelling between jobs, the capacity to operate with much larger units of equipment, and the possibility of working for many more hours in a day when the occasion demanded, meant that many farm operations could be accomplished in a much shorter period of time than previously.

Many other new machines, whether relying on tractor power or not, have also had a significant impact on work capacity and the rate of work. Having been largely relieved of manual exertion, being required instead to provide the less physically tiring effort of machine operation, the farm worker can work substantially longer hours in any day if the occasion demands. Many modern machines combine into one operation what was formerly two or three separate tasks. This integration of activities often results in significantly increased working rates. As a result, the work capacity on an average farm today greatly exceeds that available in the days of labour-based production; the capacity of the machinery complement can be equivalent to that of a very large labour force, while being superior in terms of the speed with which jobs can be completed. Coupled with the enhanced productivity

of other farm inputs, in the form of fertilizers, chemicals and improved management practices, mechanization has bestowed on Canadian agriculture the ability to produce a growing volume of food each year. Without these advances the output expansion that has been experienced over the last three decades could not have been achieved or effectively handled.

The ability to work faster and for longer periods means that critical operations in the production cycle (such as cultivating and seeding, or harvesting) can be accomplished closer to the optimum time, or with less disruption due to unfavourable conditions. With cultivation techniques which guard against soil erosion and (in some cases with the aid of irrigation equipment) ensure more favourable moisture states for crop growth, plus spraying and fertilization practices, crop yields can be higher and more uniform. Fodder conservation for livestock can be completed more rapidly and effectively with modern machinery, minimizing quality loss through rain damage. In consequence, all areas of agricultural production, and particularly crop production, should be less susceptible to weather disturbances in an era of mechanized farming. Farm output as a whole should show less variation from year to year as production approaches a controlled process.

From an examination of the evidence, however, the achievement of such gains is not readily apparent. While mechanized methods lead, in theory at least, to output stability, the year-to-year variations in output now seem as marked as 50 years ago. This is especially true on the Prairies which, being a dominantly crop-oriented region, could logically be expected to have benefited most. But for advanced mechanization, the low-output years might have been even worse. Or perhaps the larger farm sizes that are more common today make the problem of output control more difficult.

Certainly mechanized farming can introduce new and additional elements of risk with respect to output levels. For example, it is usually felt that grain has to be much more mature, hence left standing longer, for straight combining as compared with binder harvesting.[1] This raises the chances of loss from shelling or sprouting in the ear in wet seasons. Pre-cutting by swather, to obtain earlier and more even maturing, leaves the grain far less protected from birds and the elements than when it is stooked or left standing uncut. The practice of highly mechanized intensive livestock production eliminates the frequent and traditional watchfui eye of the stockman in the care and feeding of his animals, thus raising the hazard of unnoticed wasting or disease. Finally, the almost total reliance of production techniques on the co-operation of machinery means that a mechanical breakdown at some critical period can leave the farmer almost powerless to carry out his necessary tasks—and time lost in waiting for equipment repairs can have a very high opportunity cost.

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[1] In fact there is field evidence available which shows that combine efficiency can be increased by harvesting grain earlier, at a mature but pre-ripe and moister stage. To be successful, however, this practice necessitates the use of a grain dryer.

Impact on the Physical Structure of Farming

Mechanization has also had a profound impact on the basic structure of the agricultural industry and on many physical aspects of farm production. Inputs, outputs, techniques and the entire rural environment have changed as a result.

Crop Yields - One area where the effects of mechanization should be evident is in crop yields. By allowing more timely operations throughout the year in seeding, in summerfallowing and land preparation, in haying and harvesting potential yields should be more nearly achieved. Some growth in yields has in fact occurred as was observed earlier (see Figure 22.5). However, it is not clear how much of this can be attributed to the use of more and improved machinery.

During this same period, significant improvements in the yield potential and disease resistant properties of crop varieties were achieved; fertilizer use became common; herbicide, fungicide, and pesticide chemicals were developed and adopted; and the technical status of farming practice as a whole advanced on a broad front. All of these factors were themselves output-increasing in nature --indeed it is perhaps surprising that crop yields have not risen by more than they have.

However, if mechanization cannot rightly claim credit for any specific proportion of this yield increase, it can undoubtedly claim to have been an essential ingredient. For much of the yield-raising technology, in the form of improved varieties, fertilizers, chemicals and better production methods, has been dependent on farm machinery for its effective exploitation. Furthermore, the innovation of many of these advances was initially stimulated by the availability of the appropriate items of equipment.

Downing[2] has attempted to assess the contribution of machinery use to the higher crop yields, and concludes that, among the cereals, oats have probably benefited most from the advantages of mechanization. Increases in yield of potatoes is closely associated with the adoption of new machinery which permits the more effective use of fertilizer, and with advances in cultivating, planting and harvesting equipment.

Product Quality -- Mechanized methods have also assisted greatly in producing a higher quality end product. Several examples can be cited. Current hay-making and conditioning machinery maximizes the possibility of achieving a product of high feed value; barn hay-drying and grass-drying aid further in producing high quality fodder. Modern dairy equipment ensures that milk quality is maintained at a high standard. Pre-cutting and swathing of cereals prior to combining hastens ripening and produces a more uniformly mature sample of grain; grain drying further guards against deterioration of quality during storage. The sporadic growth of potatoes, resulting in tubers of irregular size and shape which are not so salable

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[2] C.G.E. Downing, "Mechanization" (paper given at a *Resources for Tomorrow* Conference in the early 1960s).

can largely be prevented by the use of irrigation equipment at times of soil moisture deficit. In many such ways the quality-improving effects of mechanization have yielded important benefits.

Expansion in the Production Area – The replacement of the farm horse by the tractor released vast areas of land, previously employed in maintaining the horse population, for use in commercial food production. It has been estimated that in Western Canada 10 acres of land were taken up in providing food for each horse. If this is so, then 20 million acres have been made available since 1921 by the displacement of the horse from Prairie agriculture. The land requirements were apparently less in Eastern Canada, being some 3.5 to 4 acres per horse; nevertheless, the demise of the workhorse has released an estimated 4 million acres in Ontario and Quebec.

The "tractorization" of farming, then, had the effect of increasing the size of almost every farm. Mechanization has further expanded the productive area of farms by enabling farmers to utilize the acreage of their holdings more effectively, making it feasible to cultivate the more marginal areas and fields more distant from the farmstead. This partly explains why the total area of improved land and the acreage under crops have increased by over 20 per cent since 1941, while the total area of farmland has remained virtually constant.

TABLE 24.1–AVERAGE FARM SIZE, CANADA AND MAJOR PROVINCES, 1921-66

(Acres)

	Canada		Quebec		Ontario		Prairies	
	Total	Improved	Total	Improved	Total	Improved	Total	Improved
1921	198	99	125	66	114	67	344	176
1941	237	125	117	59	126	75	405	221
1951	279	155	125	66	139	85	498	288
1956	302	175	130	70	141	89	545	326
1961	359	215	148	82	153	99	617	382
1966	405	251	161	95	162	109	685	437

Source: Dominion Bureau of Statistics, *Census of Canada, Agriculture,* various years.

Farm Sizes – The general progress of mechanization has not only raised the effective acreage on each farm, but has also played a significant part in the move towards larger farming units (see Table 24.1). Agricultural economists are not fully agreed on what has been cause and what has been effect in this process. Does increased farm machinery use derive from larger farm units or did it initiate the move towards bigger holdings? One thing is clear, however. The mere fact of farm operators leaving agriculture in response to the attractions of non-farm work, and farmers' sons declining to take over the family farm, results in both a contraction in the labour force and the availability of their holdings on the market. The high capital requirements on entry into modern farming perhaps deter many would-be

new farmers from taking over these holdings as individual units. In consequence there is strong tendency for these farms (particularly the smaller ones) to be amalgamated with existing holdings. This is entirely feasible where the amalgamating farmer has the available machinery capacity, or can readily acquire it, to farm the additional acres.

Thus, mechanization represents an important enabling factor in the process of farm amalgamation. For with modern equipment, one man can handle increasingly large acreages. Further, many farmers who are already well mechanized may find that they can farm additional acres within the capacity of their existing machinery stock.

The other side of the argument is whether mechanization functions as a fundamental determinant in farm-size growth. The answer to this lies in the validity of two hypotheses: (a) that farmers (especially on smaller units) are induced to give up their holdings because small-scale mechanized production is no longer economic, and (b) that many farmers, in investing in a wide complement of machinery, often cannot help but become "over-mechanized", and thus are compelled to expand their production base in order to utilize their available machinery capacity efficiently. But on these two aspects the evidence is far from conclusive.

The basis for these hypotheses is that items of equipment, coming in relatively large units, cannot always be ideally matched with a farm's available land area. Secondly, contemporary mechanization reflects a growing importance of integrated machinery systems rather than merely the mechanization of particular tasks. Consequently, in order to conduct farming methods efficiently based on a low labour input, extensive machinery investment is required. It is plausible that these pressures operate on the very small farm holdings and induce farmers either to enlarge their farms or to leave the industry. But it is difficult to associate these problems with farms up to 640 acres in size—many of which have been subject to amalgamation on the Prairies.

Whatever the truth of the above arguments, mechanization has undoubtedly had a major influence on farm-size growth by being the *sine qua non* of large-scale production.

The Rural Environment – The coming of the machine age in agriculture has brought with it an inevitable impact on the rural scene. Although providing transportation, machinery requires transportation too, and the rapid transfer of equipment from one area of work to another requires an infrastructure of good roads and wide field gateways. Large machines operate less efficiently in small and irregular-shaped fields. Consequently, fences are rooted up, ditches filled, lone trees felled, gates and roadways widened—gradually modifying the rural environment. These incursions on the natural order, coupled with the other more dramatic effects of modern agricultural technology, often evoke deep feelings of nostalgia for the more varied rural scene of a by-gone era.

Economic Impact of Changing Machinery Technology

The mechanization of production is, in the last analysis, undertaken on the basis of economic criteria and as a part of the economic evolution of the farm business. Accordingly, one would expect that the accelerated mechanization of Canadian agriculture has had a profound impact on the economic structure of the industry and the individual farm units that comprise it. Some of these changes will be reviewed here.

Commercialization of Farming – One of the more noticeable changes has been a distinct "commercialization" of agricultural production, witnessed by a marked rise in the proportion of farms identified as "commercial farms" in the Census of Canada.[3] In 1951 only 38 per cent of all census-farms produced sales of $2,500 or more, whereas by 1966 this proportion had risen to 64 per cent. This would seem to represent a genuine growth in the size of many remaining small farm businesses, rather than merely the disappearance of non-commercial holdings as separate farming units; for although the total number of farms fell by 192,569 over this period, the drop in non-commercial farms was much more at 234,314. Nor can this be explained merely in terms of the small physical output of previously non-commercial farms rising in value to exceed $2,500, for farm product prices rose by only 3.4 per cent over this period. Although much of this growing preponderance of commercial farms must lie in the disappearance of the smaller holdings and their amalgamation into larger units, there obviously remain many holdings which have not changed in acreage size but have expanded their sales above the $2,500 limit. The fact is further supported by the growth in the actual numbers of farms defined as commercial (these rising from 235,090 in 1951 to 276,835 by 1966) despite the decline in total farm numbers as a whole.

The figures in Table 24.2 portray certain other interesting features in this context. There has been a noticeable shift in the scale of output of all remaining commercial farms. Holdings having less than $5,000 of sales have declined markedly in number, while those having sales in excess of this figure have increased both in absolute numbers and as a proportion of total farms. This is especially true of the larger units selling over $10,000 of product, appreciable growth being demonstrated in all categories above this level. For example, whereas in 1951 some 13 per cent of total sales of agricultural produce came from farms in the class exceeding $15,000, this proportion had risen to over 48 per cent in 1966.

Much of this change is associated with the growing size of farms, but the economics of adopting mechanized production methods have supplied an additional and independent incentive. For example, machinery inputs must be purchased from the non-agricultural sector, which means cash payments must be made. As more farming inputs emanate from outside agriculture in this way, there has been an inevitable shift away from self-sufficiency towards production for sale. This

[3] A "commercial farm" is currently defined in the Census as one with sales of agricultural produce not less than $2,500 annually. Prior to 1966 the borderline was set at $1,200 of sales.

changing emphasis is evidenced by the fact that in 1930 about 67 per cent of total gross income was derived from cash sales of produce, whereas this proportion stands closer to 90 per cent today.

Part-Time Farming – Another facet of this growing commercialization of agriculture is seen in the rise of part-time farming. Of the reduced number of non-commercial units, by far the majority are now classed as part-time holdings. Compared to 1951 when part-time farms formed only about one-third of the non-commercial farms, by 1966 they had risen in both absolute numbers and proportions to represent 85 per cent of all non-commercial units– and an over-all 30 per cent of all farms in total.[4] Obviously many of the smaller farmers, preferring not to leave the industry altogether, but unable to operate their holdings economically under modern conditions, have been forced to resort to off-farm sources in earning some of their annual income.

Investment Level – Being a capital input with a working life of several years, the acquisition of new equipment requires a capital investment. Total sales of new machinery were valued (in wholesale prices) at \$82 million in 1946, while by 1967 this figure had risen to \$432 million. Over the period 1960-67 an over-all \$2,493 million of new machinery purchases were made. As a consequence the value of machinery and equipment assets on Canadian farms rose from \$650 million in 1931 to \$3,709 million in 1967. This rise had been part of the general growth in farm capital of all types, for over the same period the total value of agricultural assets increased by almost \$16 billion, the value of land and buildings increasing from \$4.1 to \$14.9 billion and the value of livestock and poultry from \$0.5 to \$2.5 billion.

For real estate assets, much of this increase in value is neither new investment nor even a capital transfer within the economy, but simply a paper revaluation, reflecting the rising price of farm land. These high land values are, however, real enough to the individual farmer entering the industry or planning to enlarge his farming operation by land purchase. High prices have also increased the investment in machinery and in livestock and poultry.

Capital Structure – As the aggregate level of farm capital has grown, machinery capital has become an increasing proportion of farm assets, rising from 10 per cent in 1921 to 17.5 per cent in 1967. This share has, in fact, been declining in recent years as the inflated land values have been lending more prominence to real estate capital. Real estate assets now occupy 70 per cent of total farm capital, having increased from 58.5 per cent in 1951, but it is still some 7 per cent less than in 1921. Livestock capital had increased its share to 21 per cent in 1951 but by 1967 it was only 12 per cent of the total, very similar to its share of 12.8 per cent in 1921.

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[4] Because of a change in census definition the data are not fully comparable, but the general order of magnitude of the change is beyond question.

TABLE 24.2–CHANGES IN THE SIZE STRUCTURE OF CANADIAN FARMS, AS MEASURED BY LEVEL OF SALES, 1951 AND 1966

	1951			1966		
	Farms			Farms		
Annual Sales	No.	Per Cent	Percentage of Total Sales	No.	Per Cent	Percentage of Total Sales
Over $10,000	21,243	4	22	95,032	22	65
$5,000 – $9,999	69,019	11	27	96,856	22	21
$2,500 – $4,999	144,828	23	29	84,947	20	9
Total commercial farms	235,090	38	78	276,835	64	95
Non-commercial farms	387,309	62	22	152,910	36	5
(Part-time farms, included above)	(65,135)	(10.4)	–	(129,565)	(30)	(18)
All farms[1]	623,091	100	100	430,522	100	100

[1] Including institutional farms.

Source: Dominion Bureau of Statistics, *Census of Canada, Agriculture,* 1966.

With the growth in both total and machinery capital and the reduction in farm numbers, the level of capital measured on a per-farm basis has increased substantially. (See Table 24.3.) The current value of assets per farm has risen almost eight times since 1941. Much of this rise, of course, can be attributed to the revaluation of the existing land rather than the growth of new capital in any real sense. Nevertheless, the average value of machinery on Canadian farms, standing at $8,858 in 1967, is nearly ten times higher than 25 years ago. This component of farm capital has grown faster than any other, and is clearly a result of modern machine-oriented production techniques. Coupled with the high price of purchasing land, this gives a striking indication of the level of capital required to commence farming today.

TABLE 24.3–AVERAGE CAPITAL INVESTMENT PER FARM, BY TYPE OF CAPITAL, CANADA, 1921-67

(Thousands of dollars)

	Total	Land and Buildings	Implements and Machinery	Livestock and Poultry
1921	9.2	7.1	0.9	1.2
1931	7.2	5.6	0.9	0.7
1941	5.8	4.1	0.8	0.8
1951	15.2	8.9	3.1	3.2
1961	27.4	17.9	5.3	4.1
1967	50.6	35.7	8.9	6.1

Source: Canada Department of Agriculture, Economics Branch, *Selected Statistical Information on Agriculture in Canada,* 1969.

This capital requirement does vary depending on the region and the type of farming, being highest in the Prairies. There, the combination of large farms and crop production, perhaps the most strongly machine-oriented type of farming, results in $10,450 of machinery investment per farm. Ontario farms averaged $6,727 of machinery investment in 1966, while the corresponding figure for Quebec was $5,111.

Census data on machinery capital by size of farm suggest there are scale economies in the use of machinery. Thus, investment in machinery per acre declines steadily and dramatically as the size of farm increases. For example, in 1966, farms in the size range from 10 to 69 acres had an investment in machinery of $118 per acre, farms from 240 to 399 acres an investment of $37 per acre, and farms of 1,600 acres and over an investment of only $21 per acre.

Expressing capital values in current dollars over-dramatizes the growth in farm assets. For current dollars reflect rising prices as well as the growth in real values. Applying appropriate deflators and measuring farm-asset values in constant dollars, a more realistic picture of the growth in agricultural capital, both in aggregate and on a per-farm basis, emerges. The real rise in capital stock, though apparent, is considerably less as seen from Figure 24.1. Nevertheless, it is clear that

FIGURE 24.1 – VALUE OF ASSETS PER FARM, CANADA AND MAJOR REGIONS, 1941–66

(DEFLATED USING CONSUMER PRICE INDEX 1935-39=100)

SOURCE: BASED ON DATA FROM HISTORICAL STATISTICS OF CANADA, M. C. URQUHART AND K. A. H. BUCKLEY, EDS., TORONTO, MACMILLAN, 1965; DOMINION BUREAU OF STATISTICS QUARTERLY BULLETIN OF AGRICULTURAL STATISTICS, CAT. NO. 21-003, AND DBS 1966 CENSUS OF CANADA, AGRICULTURE.

as a result of progressive mechanization in agriculture the asset structure has undergone considerable change, and the capital requirements of operating an up-to-date farming business are sufficiently high as to impose a formidable barrier both to new entrants and to further farm-size enlargement.

Debt Commitment – From the farmer's point of view, funds must be found for new investment when he wishes to expand his stock of machinery and equipment. Investments can be financed out of current earnings or by borrowing. With farm incomes subject to a cost-price squeeze, farmers have increasingly had to resort to loans when purchasing new equipment. Recent estimates suggest that as much as 60 per cent of new machinery sales are currently financed by credit from a variety of sources.

Not surprisingly, therefore, mechanization has brought with it an increasing debt commitment on the part of Canadian farmers. This higher level of loans has been extended further by the necessity to borrow increasingly large sums for land purchase as operators have sought to expand farm size in the face of rising real estate prices.

On the basis of a survey conducted by Mooney and Rust[5] it is estimated that the outstanding debt on farm machinery in 1964 amounted to $308 million, representing some 11 per cent of all farm indebtedness.[6] The Prairie farmers carried a major proportion (64 per cent) of this, since both the pace and the level of advancing mechanization have shown consistent growth in these provinces. Some 20 per cent of the machinery debt was owed by Ontario farmers with Quebec's share being about 13 per cent. There is little doubt that the indebtedness arising from machinery pruchases has risen appreciably since 1964.

Farmers' Equity – If the investment in farm machinery is economically justified then it is quite rational to borrow funds in order to achieve these advantages, rather than forgo them to avoid debt. The increased indebtedness is not bad *per se,* and may, in fact, be an indication of sound economic progress. But a higher debt commitment carries with it a potentially increased risk. Under heavy loan commitments a farmer's equity position can easily become precarious—a situation which will, however, steadily improve if the investments achieve their budgeted economies, but, conversely, may lead to an increased risk of bankruptcy if they do not.

The equity ratio of Canadian farmers has declined to less than one-half of its 1951 value, signifying an appreciable increase in farmers' liabilities in relation to their net worth. Despite this decline, farm debt outstanding was still only about 18 per cent of the value of farm capital. Thus, the over-all debt position of Canadian farmers must still be regarded as conservative. However, for many individual farmers, engaged in a planned expansion of their farm size and mechanization level, equity considerations could be potentially critical.

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[5] F. A. Mooney and R. S. Rust, *An Investigation of Farm Credit on Commercial Farms,* Canada Department of Agriculture, Economics Branch, Ottawa, 1968.

[6] R. Harris, *Farm Machinery Finance,* unpublished Commission study, 1969.

Farm Cost Structure – Adjustments to the physical mix of resources used, as production technology changed, have brought a corresponding modification in the cost structure of farming. Differential rates of price change for different inputs further alter this pattern. Consequently, as shown in Figure 24.2 the increased significance of machinery inputs has given a growing importance to their associated elements of cost–depreciation, repairs, fuels and oils. Other cost items, characteristic of modern production technology, such as fertilizers and chemicals, have also grown in size. Despite the fact that labour inputs have fallen as machinery inputs have taken their place, the total cost of labour has risen with the large increases in wage rates.

Obviously, however, the steady inflation in the economy causes all costs to rise and obscures the true changes in the relative importance of the different cost components. The impact of mechanization is more clearly revealed when the relative proportions of the various cost items are examined, as in Table 24.4. Here it can be seen that machinery costs became increasingly important in farm-operating expenditures throughout the 1940s and 1950s, but have stabilized since then and even declined moderately. Labour incurs a declining share of costs, while interest payments, as might be expected from the growing farm indebtedness, have recently assumed a growing proportion. Regional differences in mechanization are reflected

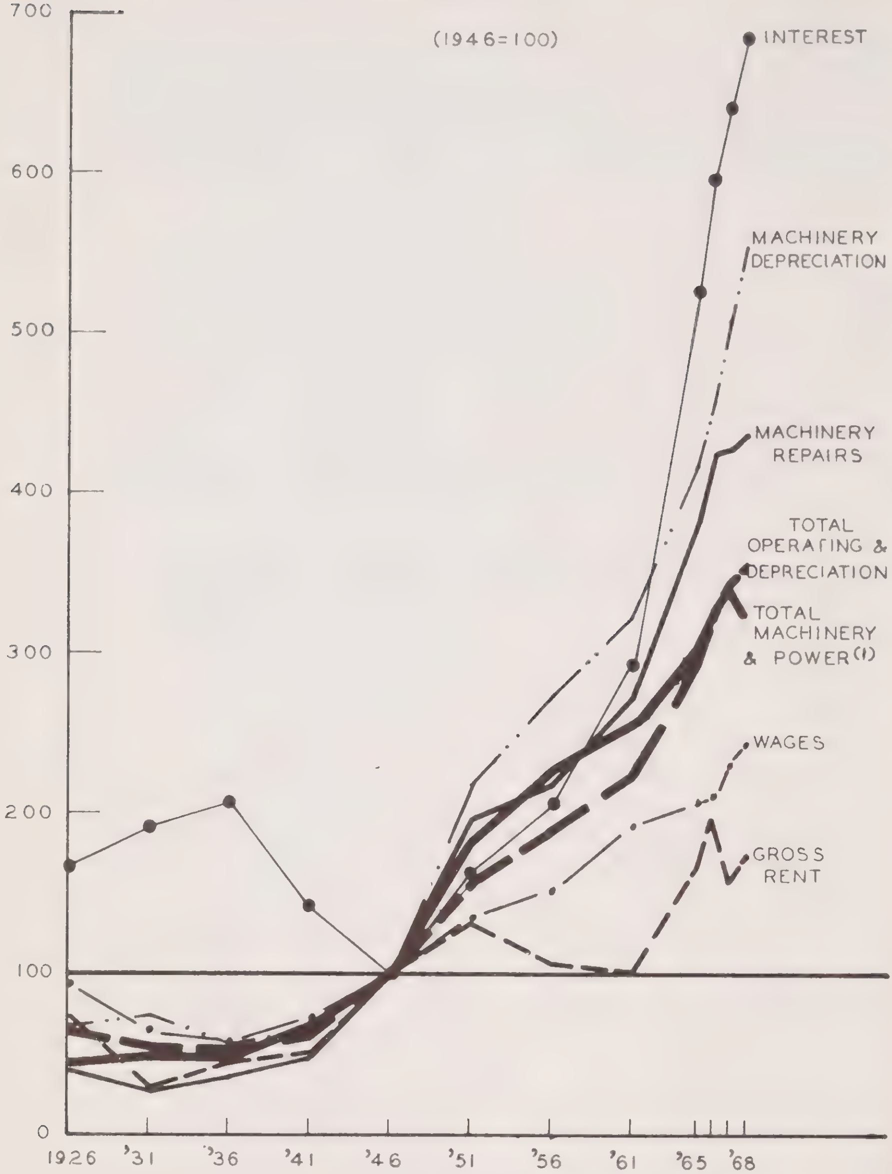
TABLE 24.4–ANALYSIS OF OPERATING EXPENSES AND DEPRECIATION, CANADIAN AGRICULTURE, SELECTED YEARS, 1927-67

	Per Cent of Total Operating and Depreciation Expense			
	1927	1947	1957	1967
Taxes	8.1	5.7	6.2	4.8
Farm rent	9.7	7.9	3.8	4.2
Wages	18.4	12.3	10.9	8.7
Interest on debt	10.1	3.8	4.4	7.4
Machinery expense	12.5	16.9	21.0	16.1
Machinery depreciation	9.9	8.8	13.7	13.1
Total machinery depreciation expense	22.4	25.7	34.7	29.2
Fertilizer and lime	0.9	2.7	3.1	6.1
Other crop	4.0	3.4	3.6	3.4
Feed[1]	10.5	24.7	16.0	17.4
Other livestock	–	1.3	2.0	3.1
Repairs to buildings	3.0	3.2	3.2	3.2
Electric power	–	0.3	1.5	1.2
Miscellaneous operating	4.1	4.1	5.3	5.5
Building depreciation	8.8	5.0	5.2	5.7
Total operating and depreciation	100.0	100.0	100.0	100.0

[1]Includes feed purchased through commercial channels only.

Source: Dominion Bureau of Statistics, based on *Handbook of Agricultural Statistics*, Part II, Cat. No. 21-511, and *Farm Net Income*, Cat. No. 21-202, various years.

FIGURE 24.2 - INDEXES OF MAJOR FARM OPERATING EXPENSES, CANADA, 1926-68



(1) ELECTRIC POWER AND TELEPHONE EXPENSE NOT INCLUDED IN YEARS PREVIOUS TO 1951.

SOURCE: BASED ON DATA FROM HANDBOOK OF AGRICULTURAL STATISTICS, PART II, 1962-65, AND FARM NET INCOME, 1968 ANNUAL.

by the fact that fully one-half of farm costs arise from machinery use in the Prairie Provinces, whereas the proportion is closer to one-quarter for all other provinces.

Off-Farm Payments – As a result of these changes, agriculture has become increasingly dependent upon inputs emanating from the non-farm sector of the economy, and a growing proportion of expenditures are paid to non-agricultural sources. In 1965 some 46 per cent of farm operating expenditures were for inputs from outside agriculture, compared with 29 per cent in 1926. Despite the benefits from the use of such resources as machinery, fertilizers, chemicals—and investment capital—this development leaves the farming community with less control over the acquisition, supply price and availability of the bulk of its inputs.

Economic Security – The terminology of production economics traditionally differentiates variable costs—those that vary directly with the output level, such as fertilizers, seeds, machinery operating expenses—from fixed costs; these latter are fixed in the sense that they do not alter in the short run with changing output levels. The rapid growth of machinery use has resulted in increased depreciation expenses (a fixed cost) which have risen more than the associated variable machinery operating costs. Similarly, annual payments on machinery debt and farmland mortgages are fixed costs. In consequence, there is a tendency for mechanization to shift the balance of costs towards a structure more heavily weighted with fixed costs.

Such a development can represent a situation of increasing risk in so far as farms have a higher proportion of costs, already increasing, which are inescapable. Whether output is high, low, or average, these costs must still be met. The risk in this lies in those years when outputs are below average—perhaps because seeded acreage was low due to poor climatic conditions or when output cannot be sold. Faced with a reduced level of returns and high inescapable fixed-cost payments, severe incursions are made into any expendable surplus. It may even mean that further debt must be incurred, or the farmer's own capital has to be invaded in order to meet these payments and continue operating, with the hope of more favourable years in prospect.

Thus, though mechanization may claim to have reduced many uncertainties of agricultural production in a technological sense, it can at the same time, by virtue of its tendency to raise farm debt and the over-all level of fixed costs, give rise to circumstances involving higher levels of economic risk.

Fortunately, the growth in fixed costs consequent upon increased machinery investment has been countered in large measure by a reduction in expenditures on labour, another predominantly fixed cost item. As a result, fixed costs[7] have only marginally increased their share of total costs, representing 48.3 per cent in 1968 as opposed to 45.9 per cent twenty years earlier. Indeed, this is a highly favourable state of affairs compared to 1928 when rent, wages and interest were vastly more

[7] Taxes, farm labour, rent, interest, building repairs and depreciation, and machinery depreciation.

significant expenditures; fixed costs at that time amounted to 67 per cent of total farm expenditures!

Nevertheless, the growth in the level of fixed costs on farms, of which machinery depreciation is a major part, means that on the average Canadian farm an annual sum of about $3,750 per farm has been incurred before any physical production commences from which financial returns may be earned.

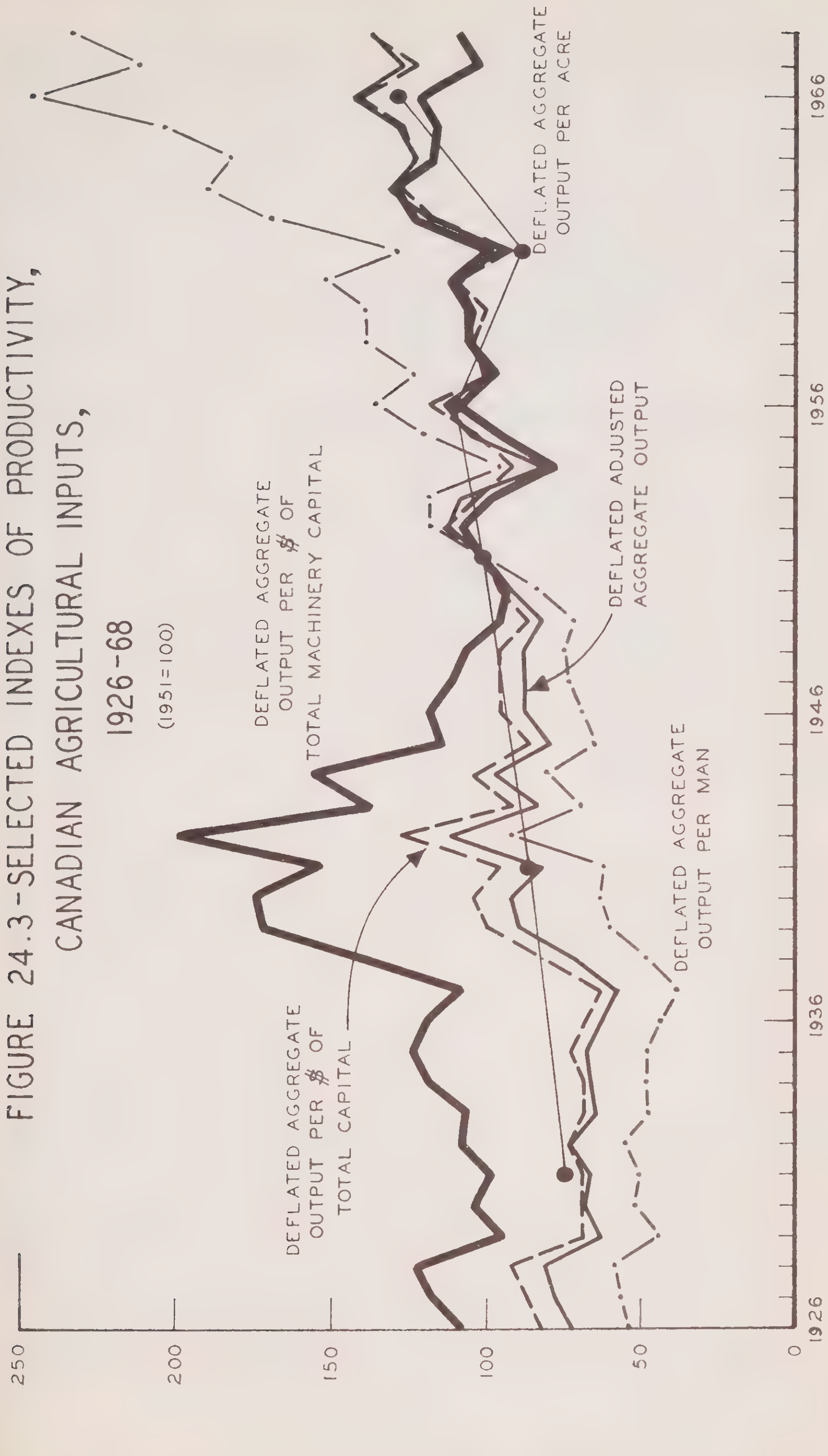
Resource Productivity – The combined effect of this spectrum of economic changes stemming from increasingly mechanized farming may be summarized in terms of shifts in the productivity of agriculture's resources. Objective measures of resource productivity, unfortunately, are notoriously elusive, since the calculated productivity of any single resource is but a partial measure being interdependent with the available levels of associated inputs. Consequently, if an increase in output is achieved by expanding the use of one resource (say, capital) while leaving all other inputs at a constant level, the measured productivities of these other resources will all, by definition, rise. But the productivity of capital may, as a result, show a corresponding fall, leaving an assessment of the change in the over-all productivity pattern somewhat indefinite. The nature and extent of economies of scale is all-important in this situation–if major economies exist *all* resource productivities may rise. Where constant or diminishing scale returns are present a mixture of opposing productivity changes will be experienced.

It is not surprising to find that the combination of an increased output from a greatly diminished labour force has conferred major increases in labour productivity in Canadian agriculture. The acreage handled by one man has risen, on the average, from 135 to 320 acres since 1931, while output per acre has doubled over the same period; as a result the real value of output per man in 1966 was almost five times greater than in 1931. Investment in capital goods is the traditional path to increased labour productivity in any industry, and these increases in output per worker and per acre emanate from the outstanding growth in agricultural capital. Total capital per improved acre now stands at $196 in Canadian agriculture, or alternatively at $38,945 per man. Though much of this is represented merely by the higher value of real estate capital, there has been a true growth in capital inputs in the form of machinery and equipment. Machinery investment per improved acre in constant (1949) dollars has risen from $9.4 in 1941 to $23.1 in 1967, and on a per worker basis the respective levels are $804 and $4,576.

While enabling a growth in productivity per man and per acre, these injections of capital have not come at the expense of greatly diminished capital productivity. Figure 24.3 reveals the progress in various resource productivities in Canadian agriculture since 1926. From this it is clear that in the early days of machine-oriented production all resource productivities showed steady improvement. During the mechanization boom of the late 1940s and early 1950s, which initiated the sharp rise in labour productivity, the productivity of machinery capital suffered a sharp drop. Since then it has remained fairly steady, while the growth in labour productivity has continued apace. The productivity of total agricultural capital has shown a fairly consistent upward trend since the late 1920s.

FIGURE 24.3 – SELECTED INDEXES OF PRODUCTIVITY, CANADIAN AGRICULTURAL INPUTS, 1926–68

(1951=100)



SOURCE: FOR EXPLANATION OF INDEX CALCULATIONS SEE APPENDIX A, TABLE A.16.

Cost-Price Squeeze It is often asserted that a concentration on mechanized production methods, combined with rising prices for machinery inputs, has contributed to a growing cost-price squeeze in agriculture. Certainly there has been a narrowing of the margin between the index of farm product prices and the corresponding price index of commodities and services used by farmers (see Figure 23.2), circumstances which many observers view with concern. But whether mechanization is one of the culprits in this situation, or even whether the so-called squeeze is of any real significance, is open to question.

For one thing, the two indexes are independent measures of elements that are, in a sense, unrelated, and there is no reason why they should move together. Secondly, the narrowing of the indexes since the early 1950s is especially noticeable because they initially diverged from about 1940. During the period 1940-50 the index of farm product prices rose much more rapidly than the cost index, and it was the collapse of this "boom" in prices which has given the appearance of a squeeze. It was during the latter part of this period, too, that a major growth in machinery investment occurred, so mechanization as such can perhaps be exonerated as a disadvantageous factor in farming prosperity.

Although the cost index has again risen more than the price index since 1960, does this have any true significance? If the price of farm inputs has risen rapidly, so too has their productivity. The cost index alone is totally uninformative concerning the quality changes that have occurred in agricultural resources. That the relatively high cost index is a superficial measure is reflected by the fact that, despite their rising prices, up until 1966 (the latest year shown) the outputs per dollar spent on labour, machinery and other inputs show no sign of a decline. In fact the reverse is true.

Finally, although profit margins per unit of output may be under pressure, the expendable surplus per farm operator has been steadily increasing. As long as the number of farmers who share agricultural income continues to decline, concern over the prosperity of farming as a whole will be tempered by this growth in income per farm operator.

Impact of Changing Technology on Farm Society

Population Balance – One of the most spectacular of recent changes in the farming sector has been the reduction of the farming population, by half, in less than 20 years. While mechanization may not be the sole cause of this outflow it has contributed very substantially to it.

The social side effects of this change have been numerous. The fact that not only are there fewer people left in farming, but also that the proportion of the total work force employed in agriculture has declined from 30 per cent to 7 per cent since 1931, has presumably resulted in a loss of political power, the implications of which may be far reaching. Since the migration has been mainly of people in the younger adult age groups, there has been a change in the age structure of the farm

population–giving a marked proportional increase in the older age groups–which foreshadows further changes to come.

The process of migration may often have been a harsh experience for the individuals involved. First there is the economic hardships associated with being slowly squeezed out. Depending on how long those involved try to hold on, this may affect many other aspects of their life such as children's education and both the physical and mental well-being of adults of the family. It results, too, in the break-up of families, and creates the need for new relationships to be forged. In this context, those who leave the farm are confronted with the many hardships and uncertainties created by the rural-to-urban transition.

Accompanying this population shift there has been an increase in the number of non-farm people indirectly employed in farming. The substitution of capital for labour has effectively increased the service force employed in maintaining farms fully operable. This force includes mechanics and repairmen, technical specialists, an expanded sales force, advisory officers and additional administrative staff. The reduction in the farm work-force has been partially substituted for by an increase in the amount of custom work and specialized contract work done on farms. No longer can the total labour input into agriculture be ascertained by counting the number of adult males resident on farms. Apart from the custom work that is done, the increase in the number of part-time farmers effectively invalidates a simple count of farm-based personnel.

In view of the movement of people out of farming, two changes which have occurred appear anomalous. The first is that many small towns and villages in rural areas have actually increased in population. This is essentially an effect of mechanization in that with more cars, trucks and run-abouts farmers can live in the towns and commute to and from their farms. The second is that, according to the published statistics, the number of adult males employed per farm has actually increased. This effect is caused by the development of certain intensive operations, particularly involving livestock, and by the disappearance of small farms that employ only the owner-operator. A corollary is that the number of farms large enough to need employed labour has tended to increase. On the other front, there is also more town-country integration, with the relative disappearance of a separate and different farm way of life.

All of these changes can, of course, be associated with increasing farm mechanization. Even though mechanization may not be an important determinant of some effects, it is, nevertheless, an identifiable feature of the times and may therefore be held responsible by association. Many of the changes that occur in the process of agricultural adjustment create upheaval and uncertainty. Thus, for many farm people, the experience of the times is disconcerting. A feature of modern farming is that mechanization and the costs related to it are increasing, and this sometimes results in machinery and machinery companies, rightly or wrongly, being blamed for some of the problems that arise. Though there are some real issues

involved, it may be this reaction, more than anything else, that has lead to dissatisfaction with the companies and to the demand for official enquiries into their operation. If the farm machinery industry were to recognize the significance of this involvement by association, and to take some action to offset it, they might avoid repeated public investigations.

Physical Welfare – A more direct impact of expanding mechanization has been that on the physical well-being of farm people. A Commission study has shown that the adverse effects are both acute, in the form of accidental injuries–and chronic, in the form of health damage.[8] Statistics on fatalities in Canada show quite clearly that fatal accidents directly related to farm machinery are increasing at an alarming rate (see Figure 24.4). Not only are they increasing in proportion to the size of farm population but in absolute terms as well. The victims are in all age groups, but particularly they are the very young and the aged as seen from Table 24.5.

Statistics on disabling and temporary injuries are, unfortunately, less complete than might be desired, but such evidence as does exist suggests that they are becoming more frequent, as are fatalities. There are also some indications that injuries sustained in farm machinery accidents are more severe than other categories of farm accidents. These effects suggest some change within the man-machine relationship on farms. Though there are clear indications that changes concerning the man, machine and environment can all contribute to the creation of an accident situation, the most obvious changes are those including machinery. The rise in fatalities would seem to be unnecessary when it is known that the modification of machinery design would effectively reduce a large number of them. Others could be avoided by increased awareness and care on the part of the farmer.

The chronic effects include hearing loss due to noise, various ailments caused by exposure to heat, cold, wind and dust, and physiological effects due to jolting and vibration. Although the statistical evidence is incomplete, these too seem to be on the increase. They differ from the acute effects in that these affect almost exclusively the operator, and not bystanders or those working nearby. The onset of these effects are insidious since they are usually cumulative over time, and the causes may not be recognized until their impact becomes acute. Again, most of these effects could be lessened by improvements in machinery design. To some extent they might also be reduced by increased awareness of their nature and by taking action to ameliorate their impact.

Overall, these adverse welfare effects appear to exceed those that are beneficial. By doing jobs faster and with less human effort, machines might be expected to benefit directly those who use them. To some extent they do. There can be little doubt that most farm operations can be done with less exertion than at

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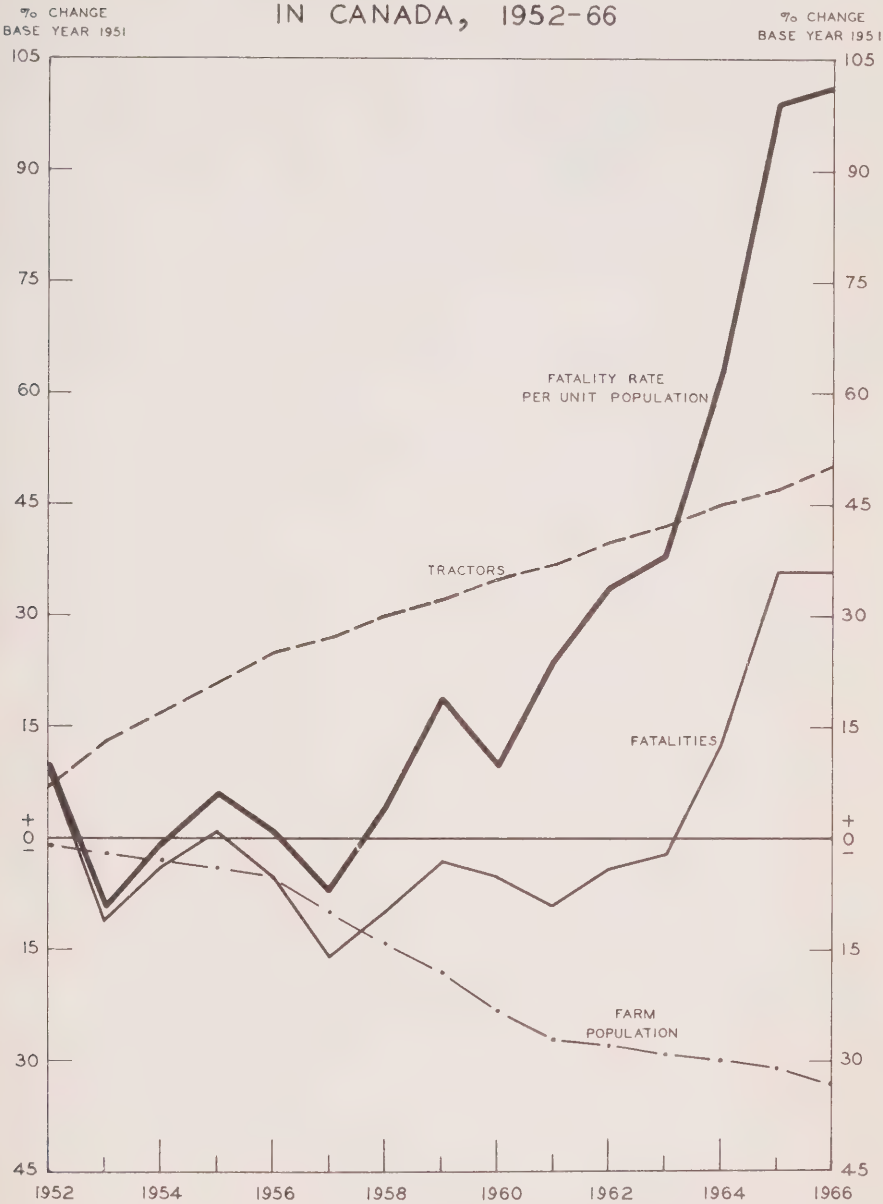
[8] G.F. Donaldson, *Farm Machinery Safety*, Royal Commission on Farm Machinery, Study No. 1 (Ottawa: Queen's Printer, 1968).

FIGURE 24.4 - CHANGES IN FARM MACHINERY FATALITY RATE, FARM TRACTORS AND FARM POPULATION IN CANADA, 1952-66



SOURCE: G. F. DONALDSON, FARM MACHINERY SAFETY, ROYAL COMMISSION ON FARM MACHINERY, STUDY NO. I (OTTAWA: QUEEN'S PRINTER, 1968).

TABLE 24.5–FARM MACHINERY FATALITIES IN CANADA – ACCIDENT TYPE AND AGE OF VICTIM, 1962-66

Age in Years	Over-turned	Crushed by Tractor	Run Over Operator	Run Over Bystander	Run Over (Other)	Servicing	Caught PTO	Caught Other	Miscel-laneous	Total	Percentage
1– 4	5	4	–	49	6	–	–	3	2	69	12
5– 9	9	2	8	13	5	–	–	4	5	46	8
10–19	46	15	6	2	11	–	3	2	14	99	17
20–29	20	4	–	1	3	1	6	3	5	43	7
30–39	23	1	1	–	3	2	1	6	6	43	7
40–49	35	5	3	–	5	4	2	6	15	75	13
50–59	36	8	10	–	9	5	5	8	10	91	15
60–69	31	3	4	–	12	3	5	3	12	73	12
70+	25	1	5	1	9	3	2	1	12	59	10
Total	230	43	37	66	63	18	24	36	81	598	100
Percentage	39	7	6	11	11	3	4	6	13	100	

Note: Percentages may not add to 100 due to rounding.

Source: G.F. Donaldson, *Farm Machinery Safety*, Royal Commission on Farm Machinery, Study No. 1 (Ottawa: Queen's Printer, 1968), Appendix II, Table 2, p. 91.

one time was necessary. Nor is there any question that many operations can be done more speedily. This latter advantage, however, has not always been obtained as a direct gain. Very often the extra capacity resulting from a higher rate of work has been used to cover a larger acreage in order to increase economic gains. In this regard, the transition from the horse to the tractor has often increased the length of the working day. Whereas the horse team had to be spelled at regular intervals, and could only be used for a limited number of hours at a time, the tractor has no such limitations. It can theoretically, and sometimes in practice, work for almost 24 hours in a day—and an operator must work with it. The prolonged hours of work that are possible tend to aggravate the chronic health effects mentioned above, and through fatigue, may be a prime cause of certain accidents. In these various ways the impact of expanding mechanization of farm people can be severe and unfavourable.

Chapter 25

ADJUSTMENTS RELATED TO CHANGING TECHNOLOGY ON FARMS

Adjustments in Farming Organization

At the level of the individual farm, mechanization has exerted far-reaching effects on all aspects of the farming organization. It has affected the size structure of farms, the farm's use of labour and capital, and the pattern of organizations supplying farm services. This section examines these changes in some detail.

Farm Organization – A predominant change has been in the acreage size of farms. As already shown, the average size of farms has increased in all parts of Canada, mainly through amalgamations. Expanding mechanization has accompanied this increase in acreage per farm, and has undoubtedly facilitated it by allowing the extra acres to be farmed with approximately the same labour force per farm. There has accordingly been a concurrent drop in labour used per acre cropped. *A priori,* there seems no reason why mechanization as such should be a determinant of this change–yet this is a widely held belief. It is frequently argued that there is much under-utilization of equipment on farms, and that in order to overcome this problem farmers seek to buy additional land.[1] [2]

This argument, in its simplest form, assumes that farmers are either unable to purchase a machinery system to suit their size requirements, or that they irrationally purchase equipment that is too big for their purpose. The first of these propositions seems unlikely to hold, once it is recognized that there is a very wide range of machinery sizes on the market–including more than 10 different sized tractors–and that the used equipment market forms a continuum of sizes in terms of price-capacity considerations. Consequently, there seems no reason why a farmer should not be able to select a capital outlay as small as is required. The second point seems illogical, in that it implies that an irrational machinery buyer subsequently becomes a rational land buyer. Though in some cases farmers will undoubtedly over-estimate their machinery needs or, because of insufficient

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[1] Anon. "Agriculture in the United States", *Current Affairs Bulletin,* Vol. 44, No. 2, June 1969.

[2] Province of Saskatchewan, Royal Commission on Agriculture and Rural Life, *Mechanization and Farm Costs,* Report No. 2 (Regina: Queen's Printer, 1956).

information, may make a wrong capacity decision, it seems unlikely that these mistakes would all be in the same direction. It seems more likely that this over-mechanization is purposeful—in other words, that farmers wish to expand for various economic reasons, and that the increasing level and scale of mechanization enables them to do so without changing their labour base. It may also be appropriate where increased mechanization will reduce production risk and where part-time custom work is a feasible income-earning activity.

Such a purposeful build-up of equipment may be a vital part of the mechanism of farm amalgamation and may help to explain the high prices paid for farm land. These prices would seem insupportable on the basis of any realistic assessment of its average agricultural productivity. An existing operation can expand its machinery base over several years, taking advantage of favourable taxation deductions and incurring only minimal increases in production costs. In association with this under-utilized stock of machinery capacity, a farmer can find the marginal cost of operating further land to be very low—being merely the extra expenditure on seed, fertilizers, and fuel. The net marginal returns from additional acres can therefore be at a correspondingly high level which, when capitalized, might appear to justify a high price being paid. There may, of course, be increased production risk involved until such time as the machinery complement builds up again.

As the process of farm growth by amalgamation has occurred, however, there has also been some polarization in the range of farm size with the maintenance, and in some areas an increase, in the number of small farms. This is a reflection of a trend toward part-time farming. Part-time farms have long existed near forestry areas, and are increasingly found in proximity to oil wells, and even near metropolitan areas, notably on the Niagara Peninsula. By enabling the operation of the farm with fewer working hours per acre, increased mechanization has made part-time farming more feasible.

The amalgamation of farms has many and widespread side effects. It frequently changes the form of tenure, as can be seen from the increasing number of farms that have some rented land. Often this represents land owned by other members of the same family, but the incidence of land owners renting their land to larger scale operators, sometimes selling them their own labour as well, is increasing.

Farm amalgamations often lead to a fragmentation of land holdings as well. For when farms are amalgamated they are rarely adjacent to one another, though usually nearby. This creates a need for more mobility, such as higher-speed road gears on tractors to expedite travel between farms. There is a related advantage in having implements either mounted on pneumatic tires or on the tractor itself. There is also a demand for mobile farmstead equipment. Fragmented farms often mean multiple and scattered buildings and therefore there is a need for handling equipment such as elevators and augers, and even for hammer mills and grain dryers, to be mobile. Storage and field operations scattered in this way increase the

amount of handling and transporting of both production inputs and outputs. This has encouraged the increase in trucks, pick-ups and dual-purpose vehicles on farms.

Increased travel, in turn, necessitates the better maintenance, if not the formation, of roads and access routes. Often this requires specialized equipment. In addition, bridges, culverts, wider gateways and generally improved access are often required. The larger machines that are bought encourage an increase in field size, the removal of fences and in some cases removal of trees, in order to increase the efficiency of their usage.

Labour Use – Adjustments in the labour force on farms are closely related to changes in farm size and in the ownership pattern of farms. The number of persons employed per farm in Canada has remained virtually constant during the last two decades even though the total farm labour force has declined by one-half. During the same period there has been a decrease in the hours of labour employed per acre in any one year, and an even greater reduction in the hours of labour used per unit of output.

Accompanying this there have been changes in the structure of the farm labour force, both in terms of age and quality. Many of the smaller farms tend to be operated by older men, and there has also been an increase in the number of women farm workers since 1951. Accordingly, the trend in mechanization is toward easier operation of machines and the growth of handling equipment which reduces heavy lifting. There is also a higher incidence of accidents in the over-50 age group. The employed labour on farms tends to be of increasingly higher quality in terms of working skills and responsibility. This type of employee can command high wages both in and outside farming. Consequently his services have to be used effectively and this means having efficient and large-sized machines.

Since the employee is very often no longer a "farm type", he can move relatively freely from farm to town employment. Accordingly he can demand and get not only wages and housing conditions comparable to those offered in towns, but also comparable working conditions–hours, leisure, and comfort and safety. Even when farmers' sons are employed in the family business today, they have better alternative opportunities and, more often than not, a higher level of training than those of their parents. Consequently, they, too, are interested in improved rewards and working conditions. It is this aspect that seems to underlie the tendency for purchasers of new machines, particularly the bigger models used on larger farms, to be interested not only in operating capacity and efficiency, but also in adequacy of control, comfort and safety features. Employed labour of "competitive quality" cannot be made to make do with inadequate equipment, nor be relied upon to improvise in order to maintain operation.

With increasing mechanization and the increasing complexity of new machines, the skills required in operation and in repair and maintenance tend to be continually increasing. This has two effects–the trend toward employing higher-skilled, more competent farm staff, and increased reliance on off-the-farm services.

These trends are reinforced by the changed labour situation on farms. The surplus off-season labour which had a low opportunity cost no longer exists. Younger members of families tend to be off to school or training courses of some kind. The paid labour is not cheap and must be used to best advantage in the most productive activities. The spare time that was once employed on the farm is now diverted to leisure pursuits. As a result the time for activities other than specifically farm operations is limited. Thus the use of off-farm services increases.

These specialist technical services are not the only ones to be increasingly used. The shortage of surplus labour means that many traditional off-season jobs are being done by tradesmen. The erection of new buildings and building repairs are examples. In this case, too, the improved specification desired often necessitates specialist skills. The economic advantage of mass-produced buildings, and the equipment that is effectively part of them, means that the erection process has to be mechanized. Once specialist machinery is required, it is frequently profitable to import services to the farm. The same applies to a variety of jobs that can be mechanized, such as drainage, fencing, and other irregular or small-volume jobs. By employing specialist labour on these jobs, the amount of labour employed on farms is clearly increased, though this change never shows up in the census.

Capital Use – Changes in farm size and in the level of mechanization on farms lead to corresponding adjustments in the level and structure of the capital stock of farm businesses. The effects of these changes are reinforced by increases in the intensity of animal-stocking rates and by increases in the value of land. All of these factors combine to make the increase in total capital per farm a striking feature of the change in farming structure. Some measure of the increase that has occurred in land values can be gained from the fact that the proportion of farm capital that is represented by machinery has recently declined. This, in spite of the fact that the actual investment in farm machinery has expanded, and that more and larger machines are much in evidence on farms.

The same general pattern of expanding capital investment in land and machinery, with a concurrent decline in the relative importance of machinery capital, is a feature of all sizes and types of farms in Canada. Overall, the smaller farms tend to have a larger proportion of both total capital and machinery capital relative to their output. This probably reflects the economies of scale that might be expected (although, if the small farms are run as part-time farms, they may quite rationally have a higher volume of machinery than there is on farms with full-time farmers).

Associated with the larger capital stock of machinery there have been changes in the purchasing decision. Annual purchases have increased both in number and value, and as each investment outlay has enlarged so has the complexity of the decision involved. The larger outlay means that the cost of decision error is increased. Because larger machines are more complex, the choice between alternatives becomes more difficult. The fact that even small pieces of equipment

may have complex interrelationships with other items in a machinery system further increases the problem. Thus the process of investing in farm machinery is one which receives increasing attention, and which is viewed with increasing concern by farmers. But, of course, changes in farm mechanization do not affect only the structure and management of farms—they necessitate adjustments by suppliers as well.

Service Pattern – Over the last 30 years farm machinery dealerships have become fewer and larger. As a result the relationship between seller and buyer has become less personal. The farmer may not personally know any of those serving him, and this can contribute to the uncertainties surrounding machinery. On the other hand, the larger dealer operation can afford to employ specialists in various aspects of servicing and repair, and can often maintain better stocks of salable goods and replacement parts.

As the dealerships have grown in size they have tended to serve a larger area, mainly because the growth of larger firms has been at the expense of the smaller ones. Thus, the distance farmers have to travel when bringing machines in for service, or when seeking replacement parts, has increased. This can be expensive in terms of both direct costs and lost time, though to some extent this is offset by the better service and fuller stocks of parts that are often provided. The distance factor has also been offset by the use of mobile service units, often radio-controlled, which provide field service particularly during busy seasonal periods.

Another feature of this changing dealer pattern has been the increased complexity of the operation. A large dealership tends to employ a number of highly trained and skilled personnel—not only in the repair shop. Often these staff attend training schools run by the manufacturer, in addition to their basic training. The skills they develop are complemented by a variety of specialized tools and equipment used both for effecting repairs and for making regulatory adjustments on complicated mechanisms. As the relative complexity of machines has increased, there tends to be less farmer maintenance and increased dependence on the dealer service.

Several aspects of the dealership's responsibilities have been extended in recent years. The increase in user dependence on specialized service is one of them. But the expansion of farm mechanization has increased other obligations too. These include some responsibility for operator training, and for safety education. In some instances this onus is passed on from the manufacturer and reflects his liability for the performance and safety of his product. The dealer also has to accept the duties associated with the warranty and service agreements that have become an accepted part of farm machinery packages. As the package becomes increasingly complex, there is growing pressure for the dealer to provide some guidance to farmers in machinery selection and in other aspects of machinery management, including its finance. This expanding role of the dealership is a reflection of the increasing interdependence of different sectors of the economy, and the same trend affects other institutions as well.

Government departments and agencies have had to adjust their policies, too, in order to fit in with a more mechanized agriculture. On the positive side, this has involved the development of appropriate taxation policies, the organizing of financing and loan arrangements and, in a few all too rare instances, of instituting special programs such as that operated under the auspices of the Agricultural Machinery Administration in Saskatchewan. Various governments have also brought in laws regulating the operation of the farm machinery companies, and they have from time to time investigated general aspects of the impact of mechanization on farms.

Various other institutions have also taken action to meet the changing situation, sometimes with governmental support. Research stations and advisory services have investigated and tried to anticipate various changes. The universities have oriented their teaching programs to meet the needs of the mechanical revolution on farms. Though the adjustments of all such organizations often seem to have been too little and too late in terms of the massive changes required, they have nevertheless been purposeful adjustments which have aided the harvesting of the fruits of farm mechanization in most cases. Inasmuch as these changes have been constructive, they provide a basis for the type of activity that might purposefully be fostered in the future.

And as has been described in more detail elsewhere in this Report the machinery manufacturers themselves have had to make extensive changes as mechanization has proceeded.

Changes in Machinery Investment

Of the many farm adjustments that have occurred in response to greater mechanization, changes in the investment pattern are perhaps the most significant. For these changes affect the management and business aspect of farming and the adjustments required lead to further changes in all aspects of farming. Since management involves adjustment to change, it is the management side of farming that in the final analysis reflects the full magnitude of the changes that are taking place.

Investment Pattern – Though the consistent increase in farm machinery investment that has taken place since 1945 has been caused partly by larger and more complex farm machines, there has also been an increase in the total number of machines. More and more farm operations are being mechanized. In order to achieve this, new equipment is required. For example there are herbicide sprayers, new forage harvesting machines and hydraulic lifting equipment. The operation of these new items necessitates additional units of more commonplace machines including tractors and trailers–and these accordingly have begun to multiply. Thus the increase in machine numbers includes both new and existing types of machines. At the same time there has also been an increase in the size of the more traditional equipment. In particular there has been an increase in the horsepower of tractors

and subsequently in the implements that they pull. Often the increase in implement size has not been proportional to the increase in horsepower, as some power has been diverted through more sophisticated transmissions which give greater flexibility and effectiveness of control, but with slightly lower efficiency in mechanical terms.

This increased complexity, and the higher technical quality that is essential to it, represents another way in which the capital cost of machinery has tended to increase. The shift from gasoline to diesel engines has had a similar effect. The latter are cheaper to run, have lower repair and maintenance costs, but also have a higher initial cost.

Another feature of the investment pattern has been caused by the emergence of "systems". Machines are rarely bought separately but as part of a matched system. The full effectiveness of many pieces of equipment is dependent on the adequacy of auxiliary items that form part of the working system. Thus, the replacement of a combine with a larger-capacity model provides little benefit unless storage facilities and handling equipment all have sufficient capacity to permit its effective operation. The use of handling equipment is a component of increasing significance in these modern machinery systems. In addition, sophisticated equipment needs to be kept under cover when not in use, so that machinery buildings add to capital requirements. To the extent that new machines are repaired and serviced on farms there is a need for specialized tools and devices to facilitate this, as well as a workshop or other place to carry out the service operations. All of these items add to capital investment related to mechanization.

Farming Operations and Constraints – The whole process of farm mechanization is tied up with changes in farming operations, particularly husbandry. Very often new varieties of machines are necessary to permit the effective mechanization of a process, as was true of tomato harvesting. New machines may be required to facilitate the introduction of a new farming method. Thus, mechanical sprayers are essential to allow the use of "minimum tillage" in cereal growing. But apart from these direct influences, many other shifts in farming practice have indirect effects on the pattern of machinery investment. The increased use of fertilizer generally has the effect of increasing yields from crops. In some cases, too, the use of chemical fertilizer permits the more frequent cropping of suitable areas. The use of herbicides to control weed growth enhances this possibility. This means that rotations can be shortened and a larger proportion of farm acreage cropped in any one year. In some cases irrigation can be effectively used to enable even more intensive cropping. Machinery itself contributes by such changes as precision seeding, and by permitting more freedom in the spacing of plants, particularly in corn growing. At the same time breeding programs provide more disease-resistant and better-yielding crop varieties, and all of these changes tend to increase the volume of output per acre.

The increase in the volume of output expands the time required to complete seasonal operations. The continuing increase in acreage cropped per man, due both to tighter rotations and larger-sized farms, further aggravates this problem. Because of the timeliness constraints on farming operations, this persistent trend causes a continuing adjustment in many aspects of farming, including mechanization. The time available for any field operation is determined by the prevailing weather conditions and the biological tolerances of the variety being grown. At seeding time in Canada, seed-bed preparation cannot begin until the ground thaws and sowing can commence only after the soil has reached a certain temperature. A very brief period exists during which seeding conditions are optimal. Before this period a loss of yield occurs due to the soil conditions. This loss is higher the earlier the seeding date is before the optimum. Similarly, the yield obtained begins to decline progressively after the optimal period has been passed due to the shorter growing period that is available. Though the length of the optimal period will vary from year to year, it sets an effective limit on seeding operations.

At harvest a similar but somewhat less rigid set of restraints is met. The start of harvest is determined by the time of ripening of the crop, and this in turn depends upon the date of seeding, the growth characteristics of the crop variety, and the weather conditions during the growth period subsequent to seeding. The time available for harvest is influenced by weather conditions that prevail once the crop is harvest ripe, and is restricted by the grain losses and loss in quality that occur in the standing crop. As with seeding, this final constraint is not rigid, but after a brief optimal harvesting period the time taken can be extended only by accepting a progressively greater loss of yield and grain quality. The rate of this loss is again determined by the weather conditions that prevail at the time, and these vary from year to year and from place to place. In some cases even small changes in location can give very different constraints. The acreage of crop that can be handled, at both seeding and harvest, is therefore determined on any one farm in any one year by the extent to which the restraints can be overcome by better technology or husbandry practices.

Capacity Requirements – Within the varying time available, the acreage of crop a farmer can grow is primarily determined by the rate at which he can complete the sequence of operations involved. Before the introduction of tractors he was limited in this mainly by the walking speed of a working team (about 2.4 m.p.h.), by the width of machines this team (of usually six to eight horses) could draw, and by the number of hours they could effectively work in any one day. Thus the acreage of crop sown on any farm was effectively restricted.

At harvest, the restraints were somewhat less absolute. The rate at which harvest proceeded was limited in part by the weather, and by the rate of work of the horse-drawn mower or reaper and binder. In general, however, the time available could be extended almost indefinitely, to accommodate annual variations in the volume of crop and in harvesting conditions. Providing the crop could be cut, it could usually be placed in stooks or carted and stacked, by enlarging the casual

labour force to meet the needs of the season. In a big crop year, or a late harvest, threshing could go on well into winter should it be necessary to do so; though the cost, in terms of grain losses associated with the length of time the crop was standing, and with all the handling involved, was undoubtedly high under such circumstances.

With the introduction of the tractor the situation initially was changed very little. The first tractors did little more than substitute mechanical power for draft power. Each tractor was regarded as being approximately equal only to a horse team. Since it pulled the same implements, the rate of work could be increased very little without loss of quality and effectiveness in operation. To some extent the tractor was less flexible than the horse team it replaced; it became bogged down in places where horses might have carried on. The one restraint effectively removed by the tractor was the number of hours that could be worked in a day. The tractor needed neither to stop for a spell nor did it tire as the day went on. The hours worked were limited rather by the fatigue of the operator and the changing working conditions during the day.

As time progressed the tractor improved, and new potentials became realized as machines were developed to suit the tractor rather than the horse team. Though eventually there was to be a whole range of new and specialized tractor-operated equipment–from redesigned cultivation implements to power-operated harvest equipment–the most significant change was in the size of the implements and equipment that could be pulled. This began steadily to increase.

Capacity-Acreage Effects – With this increase in machinery capacity the farmer was able to plant an expanding crop acreage. This had in turn to be harvested, and thus pressure increased for the harvest to become more fully mechanized. At this time, the combine, or its forerunners, which had been in limited use for some time, became widely used. The processes of harvesting and threshing became virtually a single operation. As such it was greatly expedited, but because of the nature of the machinery involved, harvesting was no longer an open-ended final operation whose vagaries could be encompassed by extending the labour force or the time taken. It became a fully mechanized activity.

This increase in harvesting capacity in turn permitted a further increase in acreage cropped, and presumably created a demand for more machinery capacity for soil preparation and seeding operations. As this was achieved, by even larger tractors and implements, the sowing operations again ceased to be the major constraint on acreage of crop per farm, so that there was a further demand for expanded harvesting capability. It is conceivable that in this way, over many decades, mechanization has progressively facilitated the growing of an increased acreage of crops on individual farms.

To the extent that it has done this, farm mechanization has been a determinant of the growth of crop acres per farm, and of farm size adjustments and the related land price movements. Such an argument assumes, of course, that either

income effects, risk aversion, or some other factor, causes farmer's goals to be oriented toward increasing their land base providing they can handle it. That such a goal is held, by some farmers at least, is well known. Thus this explanation is not wholly unacceptable. It seems considerably more likely, or at least more plausible, than the simpler notion that larger machines are bought that provide unused capacity, and that this encourages a growth in farm size in order to spread overhead costs.

Capacity-Time Effects – The increased capacity that has been achieved, however, has involved many changes apart from the growth in machinery size. Since increased capacity can be obtained by either doing the job involved more expeditiously or by extending the available operating time, there have been developments that have endeavoured to do both. By selecting crop varieties (and breeding new ones to select from), and by spreading seeding dates as widely as possible, the length of the seeding and the harvesting periods was extended as far as the biological tolerances would allow. The time available for soil preparation and seeding was utilized more effectively by the introduction of the disker, which allowed seeding directly into the stubble of the previous crop. Similarly, the harvest period was extended to some extent, and shelling losses somewhat reduced, by the practice of swathing. The use of the swather to cut and windrow the crop permitted grain to ripen more evenly so that combining could begin earlier. Since shelling losses were reduced, the length of the harvest period could be extended without the same cost involved through grain losses. Since it could put two cuts into one windrow, the swather also speeded the rate of combining in some cases.

Other innovations contributed, too, including the introduction of integrated systems. As larger and faster combines enabled larger acreages to be harvested in less time, severe handling problems arose. Hence the use of bulk handling was necessary to facilitate faster unloading and speedier removal of grain from the field. More recently the advent of grain dryers on the Prairies has shown promise of allowing harvest to begin even earlier, and of permitting more days to be used for combining when grain would previously have been too damp. When the rate of work that can be realized is dependent on all of the stages involved in an operation, there is a need for the stages to be integrated into a system. Mechanization seems likely to continue along these lines as the farm operator battles to extend his control of the production process.

Capacity-Cost Effects – Such changes in farm machinery capacity have significant cost implications. The choice of a particular capacity system is effectively a choice of a particular level of investment. Since machinery is a flow resource this investment is translated into an annual cost. Within the production year it becomes a fixed part of the unit cost. Given any one level of output, a different investment will give a proportionally different unit cost. Thus unless there is a proportional increase in the volume handled, a larger capacity system is likely to involve higher unit costs. Although this may occur, however, it may be offset by a more reliable output. A specific aim in using larger and more complete

machinery systems is the reduction of risk. Thus a smaller profit margin with greater reliability might be preferred to a sometimes higher but more variable one. The decision as to what amount of risk to accept will be determined by the financial position of the individual farm, and the attitude of its manager.

The process of mechanization generally involves substitution of overhead costs for operating costs. For instance, cereal harvest mechanization has substituted overhead costs of the swather, combine, transport and storage bins, augers, and grain dryers (all with some component operating costs) for the operating costs of stooking, loading, stacking, threshing, and so on. In view of this increased overhead component in the unit cost of the operation, it might be expected that the nature of the unit cost will be altered. This is to say that, when used over larger levels of output, the overhead costs for any given machinery system will be spread further and will thus give a lower average cost per unit of output. It is sometimes also argued that this will hold for a series of machinery systems, and that economies of scale will exist. A Commission study of seeding and harvesting costs on the Prairies shows that successive-sized systems have minimum cost levels over a narrow range of acres, and that the minimum cost varies little from one system to the next.[3] In other words, except for very low acreages when the overhead costs have not been spread (and when either custom work or a used machine would be cheaper), the unit cost of the operation for the most suitable-sized system is comparable for all scales of operation—provided the minimum cost alternative is being used.

This finding is in keeping with those from another Commission study which showed that apart from the small-farm-size groups, where scale diseconomies were measured, there was a plateau of farm sizes over which no economies or diseconomies of scale were observable in the aggregate sample.[4] Such an adjustment would be in keeping with the increasing capital investment and resultant overhead costs on these farms, a large proportion of which relates to farm machinery.

Some interesting points also arise from a consideration of the marginal or incremental cost associated with using a machinery system to cover an additional acre. From the Commission's study it was found that the marginal cost increased more sharply for seeding operations than it did for harvesting operations (see Figure 25.1). This suggests that the restraints on seeding are more severe than those on harvesting, and that the cost of timeliness is accordingly greater. The less steeply rising marginal cost for harvesting, on the other hand, suggests that timeliness effects, though significant, are not as serious as for seeding operations. The variation in both the unit cost and marginal cost of harvesting, however, showed greater variability from year to year than did those for seeding. Thus, although the

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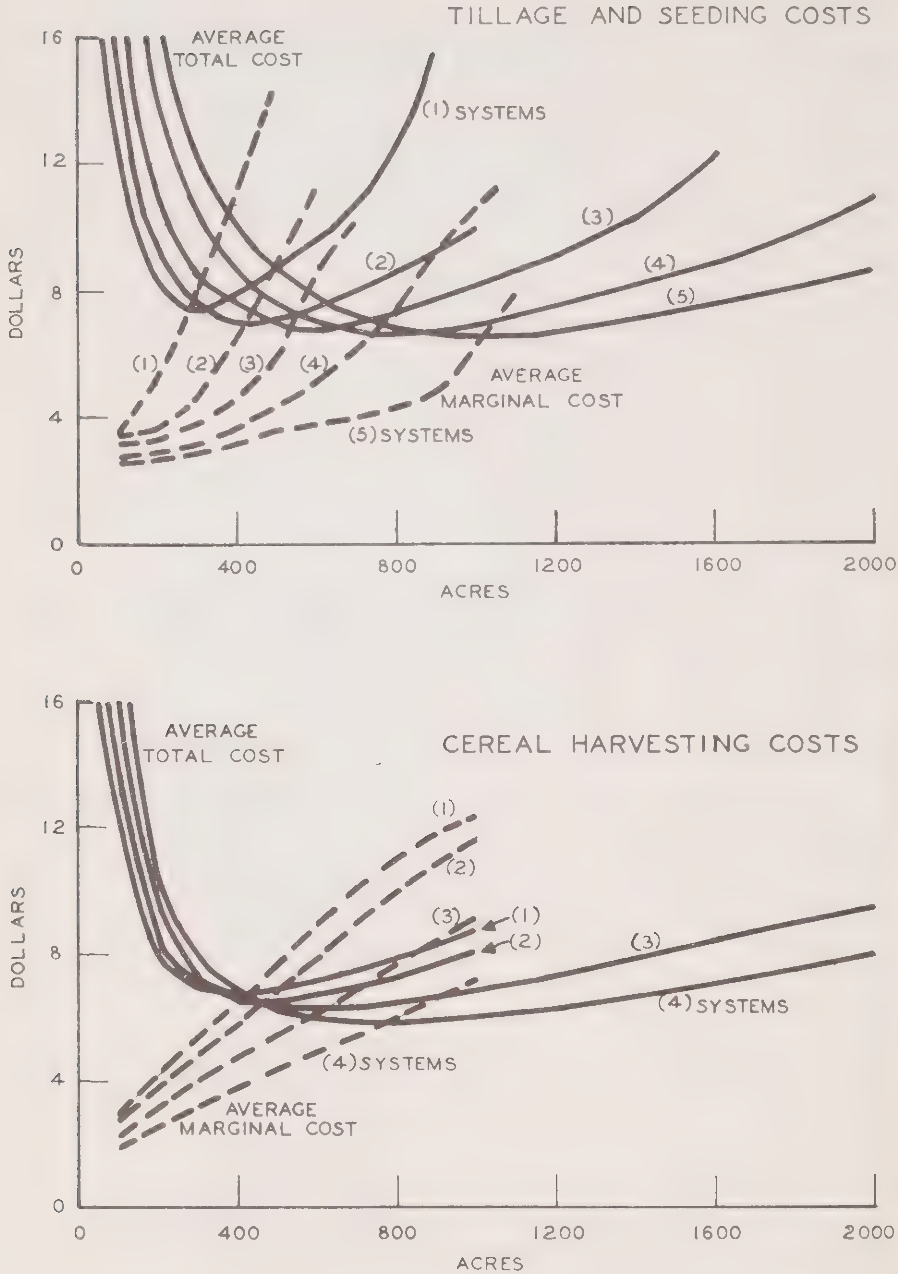
[3] G. F. Donaldson, *Farm Machinery Capacity*, Royal Commission on Farm Machinery, Study No. 10 (Ottawa: Queen's Printer, 1970).

[4] J. S. Sahota, *Economies of Scale in Farming: Analysis of the 1958 Farm Sample Survey* (data from survey conducted by the Dominion Bureau of Statistics), unpublished Commission study, 1969, as summarized in Appendix B.

FIGURE 25.1—ESTIMATED MACHINERY COST CURVES



harvest restraints are less rigid, the risks are greater from year to year. Farmers assert that their production risks are increasing over the years; to the extent that they have larger acreages carrying higher yields obtained through greater production costs (for fertilizer, seed, and other requisites) but with the same number of days and degree of weather variability, this is clearly a real concern.

These effects go some way toward explaining some of the features of the mechanization of these two farm activities. The constraints on the seeding operation suggest a reason for the large range of alternative systems that are available (including more than 10 tractors of different horsepower), since each one is suited to a fairly narrow acreage limit. For harvest operations there are fewer alternatives to choose from, and the emphasis is on additions and modifications to the harvesting system (such as grain drying), that will increase control over the harvest variables. Because of the importance of timeliness as a cost determinant at all times, there is also concern about machine reliability, and this leads to considerations of replacement.

Replacement Patterns – Since farm machinery is a flow resource which yields its services over time, each machine eventually wears out. At this stage, if not before, it has to be replaced by a new unit. Over time, the timing and the pattern of the replacement of farm machines has changed. For instance, data on the stock of tractors on Canadian farms suggest that their average age is increasing. The minimum average age of farm tractors was 5.9 years in 1951, 7.8 in 1956, 12.4 in 1961 and 14.8 in 1966. Though this trend is greatly influenced by the upsurge in purchases in the immediate postwar years, it is nevertheless a sustained trend– and at first a surprising one.

Given that investment in farm machinery has been shown to be profitable, an increase in tractor purchases might be expected. Since there is continual improvement in the level of engineering technology, a more rapid replacement pattern would seem more sensible. In view of the timeliness effects in field operations, increasingly more modern and reliable equipment would seem to be desirable. As the number of hours worked per farm each year has grown, machines might be expected to wear out sooner rather than later. Since the costs of repair parts and skilled labour both continue to rise, it would seem likely that earlier rather than later replacement would be the trend in order to substitute more slowly rising overhead costs for the faster increasing operating costs.

This is, in fact, the case. Beneath the masking effect of the increasing age of machines on farms there are several other changes occurring. First, there has been an increase in the number of tractors per farm–partly because there are fewer farms. Most farms have one tractor and many have four or five. Since there are more tractors, each can work fewer hours and decrease its workload even if the total number of hours worked on the farm were to increase (though this has in fact not happened). Thus, each unit takes more years to work the same number of hours. Second, there has been an increase in tractor substitutes on farms. These

take the form of increasing numbers of self-propelled combines and swathers, electric motors to replace stationary tractor power, and dual-purpose vehicles. The latter are particularly useful when farms consist of scattered blocks so that much road travel is involved. To the extent that jeeps (or their equivalent) and trucks are used for on-farm transport they substitute for tractors. Thus the number of operations for which tractors are used has declined and the hours of tractor work per year has changed accordingly.

At the same time there have been some changes in the replacement pattern which reinforce this hypothesis even more strongly. Although the number of tractors bought each year has declined, thus contributing to the increasing age pattern, the total amount of horsepower purchased has continually increased. Though fewer new tractors come onto farms, many of them are of increased horsepower. In addition, it is very likely that the newer and larger tractors are used in critical field operations. These two effects—tractor substitutes and larger tractors—have combined to cause the number of tractor hours used on farms each year to decrease.

The tractor replacement pattern on farms has not been the same in all regions. The major growth in the number of tractors per farm and of larger (over 80 HP) tractors has been in the Prairie Provinces. In all provinces the number of tractors per farm has increased most where the number of farms has decreased most. The over-all proportional change in horsepower per acre has been about the same in all locations.

The shift to the use of larger tractors has, in turn, created some further adjustments. The very large tractors used for field operations tend to be unsuitable for use as a second or third tractor. Consequently there is a trend toward replacing not only the first tractor with an equally large or larger unit, but also the second or third tractor, with a similar small unit. This adjustment has caused some changes in the second-hand market, with newer, larger units becoming available. It has been shown that, both economically and technically, this presents an opportunity for the increased tractorization of smaller holdings. There is evidence that the existence of a second-hand market in farm machinery is directly attributable to the fact that used equipment is worth more to farmers who use it infrequently, or who have to pay higher interest rates, than it is to those with low rates of interest or high levels of use. Not infrequently the smaller farmer may have both lower usage and higher interest charges. Thus it may pay him to buy a used tractor even though it pays the first owner to dispose of it.[5] Empirical evidence suggests that this is technically feasible too. Data on repair and maintenance costs show a different pattern and are reduced when a machine is transferred from its original level of use to a lower use level. Thus, if a tractor is transferred from a larger to a smaller farm, or from a bigger to a smaller role in the farm business, there will be some gain from the change in technical performance.

[5] W. Candler, "The Rate of Interest and the Second-hand Market for Farm Machinery", *Journal of Agricultural Economics,* Vol. 15, No. 3, June 1963.

In accordance with the changing pattern of tractor replacement, there have been changes in other equipment. Very often the implements pulled by the tractor had a longer life than the power unit–mainly because they had fewer working parts–and thus lower repair and maintenance costs. But with the escalation in tractor size it has been necessary to upgrade the implements continually in order to exploit the increased power effectively. This has meant the introduction of both different and larger implements. As a consequence of this change, more high-quality used equipment has been traded on new implements. Fortunately, the structure of the farming industry, with its many different sized units and the existence of a second-hand market, allows this exchange to take place reasonably effectively and without the cost becoming prohibitive. This alteration is one of many changes in the acquisition pattern for farm machinery.

Alterations in the Acquisition of Farm Machinery

With the growth of mechanization, extra capital has had to be found by all farms in order to stay in business. Given the rate and extent of the mechanization growth, it is hardly surprising that there have been changes in the mode of acquisition of machinery and, where it is purchased outright, in the source of capital used for purchase. Though the evidence available is sketchy, it is possible to detect adjustments in machinery purchase, in co-operative ownership, and in hiring arrangements.

Machinery Purchase – In the period 1951-66, annual purchases on a per farm basis and the stock of equipment on Canadian farms more than doubled. Despite the inflation of money values, this represents a significant increase, from \$378 to \$968 per farm for purchases, and from \$3,102 to \$8,250 per farm for machinery assets. Thus a significant proportion of new farm capital has gone into machinery. At the same time, however, there has been a massive growth in the total capital invested per farm, reflecting both the increasing land base of farms by their amalgamation with other units, and the rise in land values.

These two effects have had different implications for farm finance. The increase in investment per farm that is due to amalgamations does not alter the total capital stock of the farming sector, but it does mean that those farmers who do the amalgamating have to find capital for the purchase of additional land. Thus the growth in machinery investment has taken place in a period of capital scarcity.

On the other hand, the upward trend in land values that has been particularly marked in the 1960s causes an increase in the equity of anyone owning land. Thus most farmers will have experienced an increase in their equity base. Since this is a prime determinant of borrowing capacity, the increase in equity provides a proportional expansion in credit access. In so far as credit is used for machinery purchase, the rise in land prices aids mechanization.

Studies have shown that in the past (and particularly in the 1950s), the money used for farm machinery purchases was drawn largely from farmers'

incomes.[6] But, there is some evidence to suggest that credit has grown in importance as a means of machinery acquisition. In the years 1961-66 the capital stock invested in machinery on farms increased by 50 per cent but concurrently the estimated medium-term (1.5–10 years) credit outstanding grew by some 150 per cent. Short-term credit showed a 100 per cent increase in the same period. Since virtually all credit used for machinery will fall into these two categories, it is evident that an increasing proportion of machinery purchases is being made on credit.

Nevertheless, most analyses of demand for farm machines demonstrate a relationship between net farm incomes and purchases in any one year. This is not surprising since all purchases whether for cash or credit have eventually to be paid for out of income. High-income years may allow old loans to be paid off so that more credit might be accessible in a good year, as well as more surplus cash. A year of high income may also have important psychological effects, and may encourage expenditure by increasing confidence. There is also the point that years of high farm income are very often also years of high physical output. Thus some machinery purchases may be more essential in such years. Together, these points may help to explain the relationship found in such demand studies.

Over time there have been changes in the sources of credit used to finance the purchase of farm machinery. In the late nineteenth century, the main finance source seems to have been merchant credit and machinery company loans. As the expanding agriculture became better established the commercial banks provided larger amounts of credit. During the depression of the 1930s all credit sources closed down and there was a credit shortage which led eventually to the introduction of the *Farm Improvement Loan Act* of 1944. Subsequently, the commercial banks, backed by government guarantee, have remained by far the most important single source of farm machinery finance. In 1964 the chartered banks provided 52 per cent of all farm machinery credit, 42 per cent being backed by F.I.L.A. guarantee. The farm machinery companies provided 16 per cent, independent finance companies 12 per cent, credit unions 7 per cent, and the remaining 13 per cent was provided by various other sources. In recent years, as has been described elsewhere, credit provided by the farm machinery companies has increased in importance.

Purchase Incentives – The productivity increasing impact of farm mechanization has been well recognized by governments, with the result that many countries have adopted policies that encourage machinery investment. The precise nature of these incentives varies from one situation to another, but they mostly include: (1) special credit facilities, (2) adjustments in the rate of depreciation allowed for taxation purposes, or (3) direct capital grant arrangements.

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[6]H. G. Diesslin, *Agricultural Equipment Financing*, National Bureau of Economic Research, New York, N.Y., 1955.
A. S. Tostlebe, *Capital in Agriculture: Its Formation and Financing Since 1870* (Princeton: Princeton University Press, 1957).

In Canada, some elements of all three of these devices are used. The nature of the special credit provisions have been previously outlined. There are also favourable depreciation allowances, and almost by accident, a tax-free rebate (which would be removed by the *White Paper*). In general, for taxation purposes depreciable assets are handled on the reducing balance method of calculating annual costs. When this method was introduced, however, farmers were permitted to continue using the simpler but less realistic straight-line method of computing capital cost allowances. Most farmers have chosen to remain with the old basis, though in some ways the declining balance method is more favourable to them. Though both methods can apply equally favourable depreciation rates, the use of the declining balance method gives higher deductions in the early years after purchase and permits the bulk of the cost to be written down more rapidly. The straight-line method, which permits the writing-off of equal amounts over a specified number of years, reduces the bulk more slowly but permits the investment to be fully written off sooner.

It may be for this last reason that the latter procedure is preferred by farmers. The point is that once a capital expense has been written off it can then be sold without the proceeds being taken into account for income taxation purposes. Thus if a combine is sold after five years it can provide a handy tax-free bonus. The new combine can then be depreciated as was the old one. This loop-hole will be closed if the declining balance method is adopted as standard practice—as was recommended in the *Report of the Royal Commission on Taxation*[7] and now in the *White Paper*. As long as it remains, however, this anomaly will have various side effects.

One of these is that because of the tax-free profit on the used machine, farmers may tend to place excessive emphasis on the price obtained for his trade-in. To the extent that he does this, there is pressure for the dealership to meet his demands by raising the price paid for the used machine, and adjusting the purchase price of the new machine accordingly. This may contribute to the high list price for farm machinery in Canada, and for the high dealer margins that are allowed. Similarly the investment policy followed by farmers could be related to this short-run advantage which may not be in the long-run interests of either the individual farmer or the farming industry. It may, for instance, encourage farmers to replace existing equipment when it might be more profitable to mechanize another operation, meanwhile "making do" with the used equipment. There can be no doubt that a policy of earlier replacement is encouraged by the existing arrangement, and it seems likely that this may result in more frequent replacement than would otherwise be profitable. It does, however, provide the farmer with a bonus which, probably more often than not, will be plowed back into machinery purchases.

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[7] *Report of the Royal Commission on Taxation* (Ottawa: Queen's Printer, 1966).

Co-operative Ownership – As the level of mechanization continues to rise, there is obvious incentive for some sort of co-operative ownership, particularly for equipment that is little used. Two forms of joint ownership are commonly found, sharing and syndicates. The more informal arrangement of equipment sharing is common practice in farming areas, and always has been. Very often the sharing is done within a family group, or some other identifiable social group. In many cases the arrangement takes the form of specialized ownership wherein each farmer will own the specialized equipment used in a different operation or enterprise. The sharing arrangement often provides the dual advantage of reducing machinery costs and providing specialist labour. It is, however, an arrangement characteristic of family farming. As such, and as farming becomes more commercialized, it can be expected to decline.

Syndicates are a more formal sharing arrangement. Here the owning syndicate has a corporate identity and the machine users each become shareholders. It has the advantage that not only are machinery costs per farm reduced, but also that the capital borrowed to finance the machinery purchased is not held as a debt against the equity of the syndicate member. Thus, it is a means of obtaining access to capital without direct borrowing. In some cases, special credit provisions are made for syndicates, which further enhance their virtues.

On the other hand, syndicates provide some operational snags particularly in relation to timeliness and maintenance. For operations involving timeliness restraints there are obvious organizational difficulties involved. The machine is perhaps wanted by several people at once and this can result in both economic and social problems. There are often problems, too, with repair and maintenance and general user care in operation. The operating costs of a syndicate-owned machine often exceed those of an individually owned one. For all this, however, syndicates do have financial advantages, and they can be used for specialist and off-season activities. On a larger scale there may also be a useful arrangement when establishing grain-drying and storage facilities, or any other activity that can profitably be centralized.

Hired Facilities – The logical alternative to co-operative ownership is to make use of hired facilities. Again there are two kinds often found–custom services, and machinery rental. Both types tend to exist in a variety of forms, from the highly organized and professional to the disorganized and casual.

A variety of different operations are done on a custom basis, the best organized being cereal harvesting. A much larger acreage than now was so harvested in the 1940s when machinery was scarce. Sometimes this has been done by large operations that move thousands of miles, beginning in Texas and moving northwards. In other cases the work is done by a small local operation, which may have two or three machines. In other situations still, custom work is done by a farmer with surplus capacity–usually for a neighbour. In an industry where capacity requirements vary annually, the existence of this type of contract arrangement is a vital flexible element in the total system.

Custom services have the advantage that they involve no capital outlay (or where they are used in emergency situations, lowered capital outlay). The use of custom services consequently involves no fixed or overhead costs, though they usually come at an increased unit cost. They also have the advantage that, along with the machine, the farmer employs the specialist labour provided.

The great disadvantage of being dependent on custom services is the timeliness factor in seasonal operations. Custom operations are never available when they are most wanted–for the very simple reasons that (1) all other producers in the same area will want them at about the same time, and (2) the time when they will be needed varies from season to season and cannot be predicted more than a few weeks ahead. Their full advantages can be gained, however, in non-seasonal operations and in those seasonal activities that do not have active timeliness restraints.

The alternative to custom work is to make use of machinery rental facilities. Rental arrangements have not been widely available on a formal basis, but they are increasing. For convenience, three different categories may be delineated. Lease-hire arrangements are the first. These are common in industry and likely to increase in farming. The advantages are that it provides a modern machine, at a fixed annual cost without risk of large expenditure due to breakdown. There is usually provision for rapid replacement in case of a major breakdown. No capital outlay is involved and all risk is taken by the vendor. The only disadvantage is that it might be cheaper to own rather than to rent.

Rental agencies are the second category that provide equipment on a rental basis, sometimes with an operator, in which case they are similar to custom services. This type of service is obviously useful for non-repetitive, non-seasonal jobs for which special equipment is necessary. To the extent that a wide variety of specialist machinery is available such services do provide a means of getting access to the best machine for the job.

Machinery dealerships provide the third type of rental. Very often this is an irregular part of their business, but many if not most dealerships will at various times rent machines to their farmer clients in an emergency. Together with the custom work done by neighbours, this forms the safety valve on many seasonal operations. The present trend suggests that dealerships in the future might provide lease-hire and rental facilities as a standard stock-in-trade. For all this, however, the greatest proportion of farm machinery is still likely to be acquired by purchase, partly on credit.

Changes in Management Decisions Concerning Machinery

From the foregoing discussion it is clear that there has been an abundance of adjustment and change associated with the continuing process of farm mechanization. All such change creates effects of its own. Change is the fundamental cause of uncertainty, since many changes and their outcomes cannot be anticipated.

Change is also a prime determinant of the need for decision-making, since, without change, decisions could be taken once only without need for further repetition.

In their management decision-making, farmers are confronted with a burgeoning complexity associated with the progressive change taking place in their farm businesses. The changes concern the over-all operating environment, including the marketing and policy framework; the planning and organization of production, including the choice of enterprises, activities and resources; the control of the business, including purchase and selling arrangements; and the day-to-day regulation of operations within the production process. Mechanization causes adjustments in all of these aspects of farming. As the rate of mechanization increases so the number of decisions multiply, and as the level of mechanization grows so the number and complexity of production decisions expand proportionately.

The multiplicity of decisions necessitated by technological change create a demand for information. Decision-making involves the evaluation of alternatives to permit choice, a process which hinges fundamentally on the availability of appropriate information. As all activities involve decisions, so many phases in farm production and the use of machinery necessitate the acquisition, analysis and assessment of large amounts of information.

Some changes may create a need not only for larger amounts of information, but also for a different kind than has been required in the past. This situation is demonstrated in the case of grain drying on the Prairies. The introduction of artificial grain drying has caused a need among farmers and advisers for detailed technical information on the growth and maturity of plants, on the physical and physiological process of drying, and on the resulting biological and chemical changes in grain qualities, as well as on the operation of dryers themselves. Associated with these relationships there are complex cost, market and price implications that need to be taken into account. In this particular case, the changes affect not only farmers, but machinery manufacturers, government agencies, market authorities, and food processors as well. Therefore, the type of information required is determined by the type of decision involved, the time and level at which the decision is to be made, and who the decision-maker is. Furthermore, the type of information that is useful will depend on the analytical tools available to facilitate the increased accuracy of decision-making.

The extent to which information is useful, in terms of the farmer's changing management decisions concerning machinery, is determined by three aspects of each decision situation: (1) the degree of certainty regarding the outcome of possible alternative courses of action; (2) the economic consequences of choosing other than the best course of action; and (3) the amount by which the information (if available) is expected to reduce the initial uncertainty. Each of these elements can be expected to change over time.

In spite of technical improvements that have allowed better control of many aspects of farm production, the range of outcomes, inherent variability and

resultant uncertainty associated with all the alternative actions has, in a purely physical sense, rarely been reduced. It is only when the technical advance is applied with full knowledge of its implications and information on its range of effects that uncertainty can effectively be lowered. Both the greater variety of feasible alternatives and the technical complexities of producing crop and animal products would seem in every case to have increased. Concurrently the extension of new technology has caused some variable restraints which cause uncertainty (such as the time available for the cereal harvest) to be more fully stretched. All of these adjustments increase the range of uncertainty of alternative actions unless the relevant information is available and used. Such information is, of course, really an integral part of technical improvements.

Similarly, as production yields have grown, and total output and revenue from increasingly larger farms have become greater, the potential loss of income due to uncertain events has progressively enlarged. As production has become more mechanized and capital has been substituted for labour, the level of fixed costs as a proportion of total costs has also increased, and the total expenditure per acre or per livestock unit has expanded. Thus the potential loss from costs incurred in production has grown more serious. Since the consequences of alternative actions must be expressed in relative terms, the potential loss of benefit will vary from one situation to another. However, as the range of possible outcomes is extended, some of the possible economic consequences become more dire. Thus the uncertainty confronting the farmer in his management decisions is increased.

Despite this general pattern of developments, the actual performance of farm production on individual units has in most cases not demonstrated this variability. This is because the many changes in farm production that might give rise to this potential variability are, in most cases, introduced or implemented only when information about their effects and effectiveness is fully available. This information allows the new technology to be applied in most situations without an increase in uncertainty proportional in magnitude to the physical and economic adjustments themselves. In terms of the third of the three elements specified above, the amount by which the relevant information can reduce the related uncertainty is very great. As a consequence, the acquisition and use of increased knowledge and detailed information is a predominant characteristic of the mode of operation of the modern farmer.

The extent of the adjustment in this aspect of farm life can be observed in the proliferation of communication channels between various sources of information and farmers. The farmer is surrounded with journals, bulletins, and reports; he is bombarded with information at courses and schools, and by individual technical advisers; he is urged to be scientific and efficient through the mass media of radio and television. This network is supported by government agencies with their research centres and advisory services, by universities, colleges and schools, and by commercial firms. These are all in addition to the farmers' associations and the traditional service professions of accountancy, law, and marketing.

All of this activity is facilitated by an expanding professional group of "agrologists" who work in these various organizations, and to a growing extent as private consultants. The continued expansion of these services has been maintained in recent decades even though there has been a reduction in the number of farms. Thus the proportional growth has been much greater than is often recognized. This particular adjustment related to changing technology in the farming scene is perhaps the most easily observed but the least well recognized.

The use that is made of the information is extensive, even though farm practice lags behind precept to some degree at all times. The external channels are effective in reaching most if not all farmers, even though many farmers obtain much of their information second hand from their fellow farm managers. An effective information service does not need to reach all users directly, provided the facts are passed on. The significance of this aspect of farming can be judged from the observable fact that it is often those farmers who are not inclined or able to make use of the available flow of information who find their economic existence in jeopardy.

In view of the special role that farm machinery plays in present-day farming, and of the proportion of farm costs that mechanization represents, information concerning machinery and machinery decisions is of particular value to the farmer. Yet of the total expenditure on all formal scientific information services to agriculture, less than 10 per cent (and probably less than 5 per cent) is devoted to obtaining and distributing information on farm machinery and mechanization. As a consequence, the information that is passed around is imprecise and of poor quality. To a large degree, farm mechanization is the one aspect of agricultural production that remains the safe domain of the non-technical journalist—though this is clearly not always the case. As a consequence, the farmer finds himself on least solid ground when making decisions related to machinery. This cannot only lead to wrong or less-than-satisfactory choices of alternatives, but it may be a determinant of a far-reaching unease and subsequent disquiet among farmers concerning this aspect of their operations. It seems likely that this situation might be a root cause of the type of pressure that has lead to publicly expressed concern about farm machinery problems and to the origin of this Commission.

Chapter 26

IMPLICATIONS OF CONTINUING FARM MECHANIZATION

The adjustment pressures on Canadian agriculture since the end of the Second World War are symptomatic of the process of growth in an economy. As a nation becomes more affluent, the traditional industries, particularly agriculture, though continuing to grow in absolute terms, undergo a decline in importance relative to the rest of the economy. With rising income levels the demand for agriculture's output grows at a slower rate than aggregate demand in the economy, and earns a declining share of the consumer's dollar. As the Canadian economy continues to develop, both in size and in structure, these adjustment pressures will continue to operate on the agricultural sector. And since farm mechanization has, in many senses, come as a response to these pressures, so it can be expected to play an important role in the future adjustments in farming.

On the other hand, perhaps a new phase in the process of mechanization has been, or soon will be, reached. The emphasis in future developments is likely to be on major refinements to already mechanized operations, and on exploiting advanced and sophisticated technology within the existing structure of machinery use. Having reached the stage where machines are an integral part of farming activity, the role of mechanization is now shifting away from mere labour substitution and the augmenting of manual effort. It has now become an indispensable component of farm production, an input upon which the continued operation of Canadian agriculture is dependent. With such pre-eminence in the agricultural sector, it becomes of critical importance that the future advances in farm machines are exploited in such a way that the full benefits are derived, both by the farm community and the nation at large. For this to be realized, a series of problem areas, both extant and potential, deserve examination and attention.

In this chapter an attempt is made to envisage some of the more predictable changes, both in the agricultural industry and in the machines it relies upon, and to anticipate the problems that may develop.

Changes in Agricultural Production

Product Prices and Costs – A comparatively slow growth in demand for agricultural products, coupled with the continually expanding output that has

resulted from the application of improved varieties and new farming methods, has produced continuous downward pressure on farm product prices relative to the prices of farm inputs and prices in other sectors of the economy. This is often referred to as a "cost-price squeeze". The term is not strictly accurate since costs depend on the effectiveness with which inputs are used as well as the prices at which they are purchased.

This relative price pattern has impinged differently on the two major sectors within farming—crop production, and livestock production. In general, prices of livestock and livestock products have been rising more rapidly than prices for crop products. In part, this reflects the fact that demand for meat and dairy products has a higher income elasticity (increases more in percentage terms as per capita income rises) than is true for breadstuffs. In part, too, it reflects the fact that mechanization has been more extensively applied to crop products with presumably greater cost reductions as a result. Indeed, the crop sector of agriculture has already reached an advanced stage of mechanization, whereas the scope for analogous developments in livestock farming is still relatively unexplored.

Future developments in costs and prices are difficult to assess with any confidence. Prices of agricultural products in Canada are strongly dependent on a continually changing world export market. On the input side it seems likely that further increases in prices can be expected. Agriculture's dependence on purchased inputs has been growing, and the prices of these inputs are likely to move more in line with prices in the industrial sector than with the level of agricultural prices.

Labour Loss – An additional facet of agriculture's adjustment to its new role in a contemporary economy is the continual loss of labour to the non-farm sector of employment. Farm wage rates have traditionally lagged behind those in the rest of the economy, and entrepreneurial earnings in agriculture have frequently fallen short of potential earnings in alternative occupations. The effect of these divergences over time has been to draw labour off the farms, until Canada now is approaching a type of agriculture utilizing very low labour inputs. There seems no reason to expect these pressures to cease for some time yet. Many farm operators will continue to be attracted by the earnings, the work, and living conditions of the towns and cities, and the agricultural population will decline as retiring farmers are not replaced by new entrants to agriculture. In addition, a continuing rise in farm wage rates seems likely to provide farmers with an incentive to substitute machinery for manpower.

Thus, future mechanization will see a continuation of past trends. As the labour force declines in size, the stock of machinery in use on farms and new investment in all forms of productive assets will rise. Ultimately, however, there must come a point where this trend will change in character. For the foreseeable future, machines will still require some minimum amount of labour to operate them. In the last analysis, therefore, machinery and manpower become complementary inputs, and continued labour loss will become a constraint on further

mechanization rather than a determinant. Until that point is reached, the continued growth in farm machinery use can proceed unabated. But since there remain few operations which are as yet unmechanized, the main development is likely to be in the form of larger and higher-capacity machines to enable the spectrum of farm work to be accomplished with even less labour. As the horsepower rating of tractors continues to rise, further labour migration will occur.

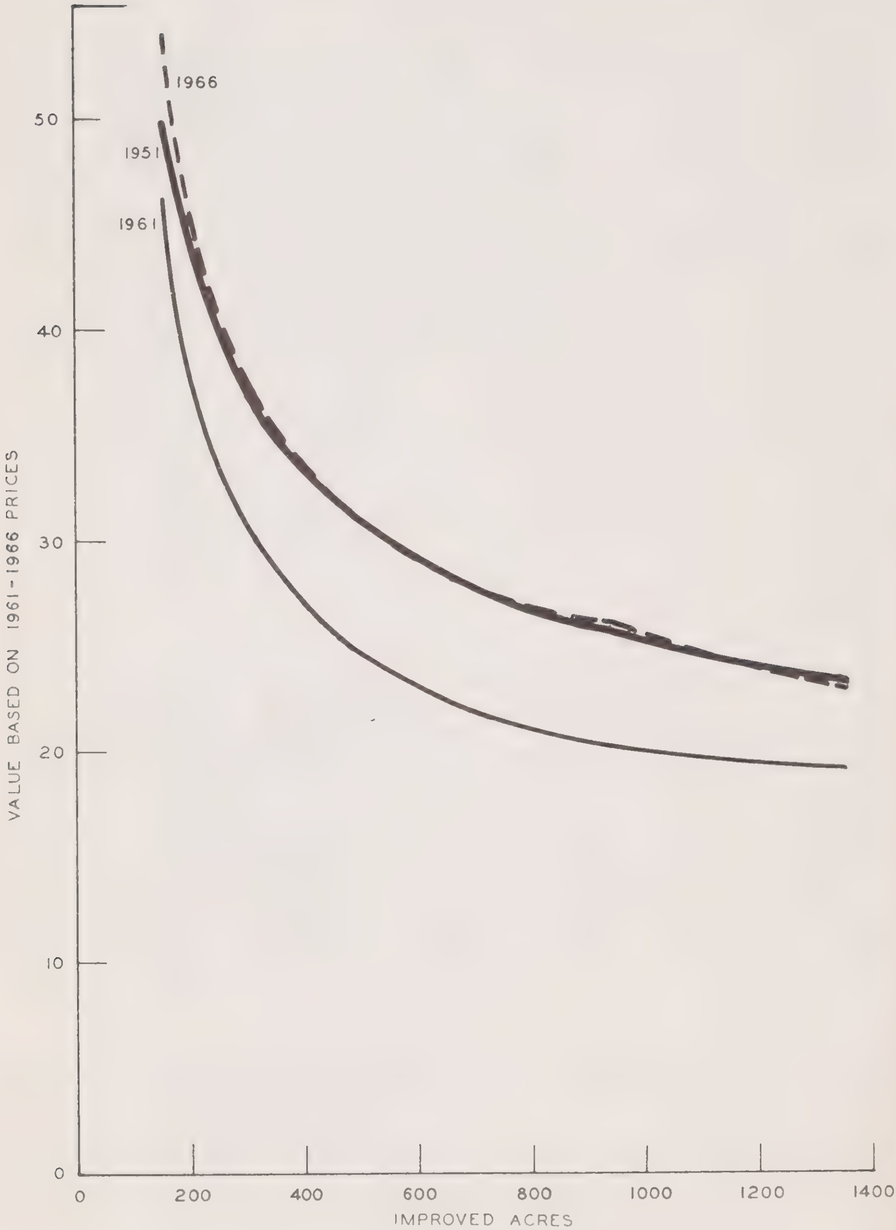
The Commercialization of Farming – Canadian farming will continue to become more commercial. The data of Table 24.2 show clearly that the number of farms that sell more than \$5,000 of product annually has increased over the years, despite the reduction in total farm numbers. Furthermore, there is a noticeable growth in the average size of farm business, with more and more holdings moving into the category of sales in excess of \$10,000. At the other end of the spectrum, many of the small and previously non-commercial farms are now classified as part-time units and this trend, too, might be expected to prevail into the future.

The commercialization of farming is an understandable development that stems directly from farmers' attempts to survive in an increasingly competitive environment, and from their specific need for cash earnings to purchase essential inputs from the non-farm sector. A study of farm changes since 1951 demonstrates that the dividing line between farms that are declining in number and those that are still increasing lies at the level of \$5,000 in annual sales for Canada as a whole. There are also indications that this "survival level" of farm size is gradually rising over time. While this is a fairly neutral method of identifying the forces operating on farm businesses, it does give some indication of the course of change that might be expected in the future.

Farm-Size Enlargement – Although farm size in terms of acres is a significantly distinct concept from size in terms of annual sales of produce, there have been obvious parallels in the change of farm size as measured on both bases. Increases in the average size of farms have been directly associated with the decline in the labour force as farm operators left the land, and the consequent reduction in farm numbers. With further migration of labour expected, the upward shift in the distribution of farm sizes must therefore continue. The indications from a survival analysis of farm changes since 1951 are that farms above 560 acres are the only ones *not* declining in number. Since almost 80 per cent of Canadian farms are smaller than this, the possibilities for further reduction in farm numbers, and hence expansion in farm sizes, seem extensive. Even when this type of analysis is applied on a regional basis, a similar conclusion emerges.

If this trend does continue, its impact on the mechanization of farming raises certain interesting issues. Since farm-size growth and labour loss are directly related, one consequence will be an ever-increasing area of farm land being handled per man. This will require a further expansion of the work capacity of tractors and associated machines in order that the farming tasks can be done effectively. At the aggregate level, the indications are that the growth in the level of machinery

FIGURE 26.1- INVESTMENT IN MACHINERY AND EQUIPMENT PER IMPROVED ACRE, BY SIZE OF FARM, CONSTANT PRICES; CANADA, 1951, 1961 AND 1966



investment may slow down. This conclusion is supported by Figure 26.1, showing that as farm size increases, the machinery stock per acre tends to decline. Similarly, when farm size, as measured by the value of products sold per farm, increases, the amount invested in machinery per dollar of product declines. For farms selling products worth $35,000 or more annually, the value of farm products sold per dollar invested in machinery was, in 1966, $2.78. For farms with annual sales of less than $2,500 the corresponding figure was $0.32.

Capital Acquisition – Although appearing as a trend that is occurring autonomously, farm-size enlargement is such that it may soon give rise to major problems that have not previously been met in the procurement of agricultural capital. When a small farmer decides to turn towards the non-agricultural sector for employment, his holding may remain as an integral unit or may be amalgamated with another farm. Farm size will therefore be enlarged in this latter manner, but in one of two ways. If the farm was previously occupied by a tenant, the tenancy could be simply taken over by the farmer amalgamating the holding with his own. This method has obviously been characteristic of recent years, as witnessed by the decline in the number of farms occupied solely on a tenancy basis, and the rise in part-tenant, part-owner tenure. Conversely, the farmer amalgamating the new land with his own may have to purchase the land in order to bring it in as part of an expanded farm business. In this case, he will require access to sufficient capital to enable purchase. Since the availability of farms that are entirely rented is now quite low, farm amalgamations by purchase will necessarily become more and more frequent, and the high level of land prices will begin to have a more significant impact on farm enlargement than they have heretofore when tenanted farms were more freely available. That this is already occurring is borne out by the fact that the proportion of owned farm land has risen fairly consistently since 1941, with tenanted land becoming an increasingly rare commodity. This trend could be offset if migrating owner-farmers were to make their land available for amalgamation on a tenancy basis. But with the high capital values represented by land assets, the relatively low rates of return on this investment under tenancy, and the understandable desire of the farmer to take his capital with him to aid the transition into the non-farm sector, this seems an unlikely possibility. If capital availability becomes an important factor in farm-size enlargement, it will likewise tend to operate as a restraining factor on further investment in mechanization.

Part-Time Farming – The migration of labour from agriculture can also take the form of farmers assuming a dependence on the non-agricultural sector for the bulk of their income, but retaining their farms for operation on a part-time basis. If this development becomes common, especially among the smaller farms, a series of implications for both national farm policy and continued mechanization are evident. Dominant among these are that the "small-farm income problem" may, in the extreme case, diminish as a cause for concern, since there seems little obligation on society to support the agricultural earnings of an individual who is only minimally dependent on his farm as a source of income, and who perhaps

voluntarily subsidizes his farming activities by off-farm work. Secondly, if part-time farming becomes an established facet of Canadian agriculture, this could conceivably lead to a disproportionate expansion in machinery investment on such farms. Being a type of production that portrays *par excellence* the minimization of labour inputs, it becomes rational—even essential—for a high level of machinery capacity per acre to be maintained.

Developments in Mechanization — Along with adjustments in the nature and organization of farming there will inevitably be many changes in the type and operation of machines used on farms. The nature of these changes will be determined by (i) the role that machines are called upon to play in future agricultural production, and (ii) the materials and components that are available for use in farm machines. These determinants will vary as time progresses in accordance with many other changes—both economic and technological. Consequently, the exact form of future innovations is not known and cannot accurately be predicted. On the basis of trends, however, some indication can be obtained concerning the direction in which developments in farm mechanization will go, at least in the short run.

As indicated previously, the predominant role of farm mechanization has been in substituting for manual effort, and this process will continue. But mechanization has not been acting this way exclusively, as there are many operations now mechanized that would not be feasible without it. In the future, more operations will be in this category as machinery begins to substitute not only for manual effort but for the working skills of the operator as well. In this way, we can anticipate improved control devices, automatic regulation, and even remote control, to become part of the farm scene.

Another change will follow from the march of technological progress itself. It can be argued that since the investment in research and development today exceeds that of any previous era (and this is manifest in the fact that 90 per cent of all the scientists who ever lived are alive today), we might expect the rate of technological change to be increasing. If this is so, then it is likely that new machinery will also substitute for existing machinery, in that new equipment will do existing jobs faster, more effectively, or in a different and preferred way. As this trend ensues, "functional obsolescence" is likely to increase; instead of becoming physically obsolescent through wear and tear, machines may become redundant because the new generation of equipment is superior in function.

The trend in the use of machinery to combat production risk is likely to continue in those areas where it has begun, and to extend to others. As more and more biological processes become understood by man, and thus subject to his regulation, mechanization will be extended to facilitate this control. Concurrently, changing economic conditions will allow existing technology to be extended to more applications. Thus, for instance, the production of various kinds of livestock can be expected to reach the technological sophistication of the broiler industry.

There will also be an extension of measures that offset the timeliness restraints of crop production, including grass and grain drying, the use of chemicals to adjust maturity and harvesting times, and breeding programs to provide cereal varieties that mature in sequence, and fruit varieties that lend themselves to mechanical harvesting. In addition, there are likely to be developments that allow machinery to operate in less favourable conditions—particularly on wetter soils—thus reducing the risk effects of weather on field operations.

The machinery developments that occur in order to fulfil these new functions, and those that substitute for existing machines, will depend on the application of new technology, materials and methods in machinery development and manufacture. The current trend in technical development suggests that there will be increased use of hydraulics both in transmission and in leverage applications. There will also be extended use made of electronic devices. Electronics will permit the monitoring of different operations or systems so that a continuous watch can be kept on performance. Although early uses, such as the grain-loss monitor on combines, will merely permit manual corrections to be made, there is but a short step from this to automatic adjustment—also facilitated by electronics, in combination with hydraulically operated mechanisms.

The use of new materials and methods that are the by-product of space research might also be anticipated. Thus there are likely to be better steels and alloys used in manufacture, and extended use of plastic and nylon materials and anti-friction coatings on wearing surfaces. New technology will also be widely seen in transistorized electrical systems, improved hydraulics and air filtering, better lubricants, the use of design refinements in structural components, and in advanced suspension systems including the use of the hovercraft principle. These various changes will show up in different machines and uses, but obviously some will have greater potential in certain applications than in others. These differences become apparent when consideration is given to potential developments in existing farm operations.

New Applications — In crop production, there will be changes in all phases of production. Seed-bed preparation and seeding will involve essentially the same sequences but different means will be used. Instead of moldboards and disks, increasing use will be made of cultivating tines, which give a better mulching effect. Both low- and high-speed traction might be used, in different situations, with tines designed specifically to suit the working speed. Tines are likely to be coated with anti-friction surfaces, to increase cultivating efficiency. Alternatives to this might be the use of fluid lubrication to ease the passage of the tine through the soil. In some situations, too, it may be possible to use electro-osmosis to achieve the same effect. This is done by using a charge on the blade surface to attract oppositely charged moisture particles in the soil. Another alternative in some situations may be the use of vibratory power—energy in the form of sound waves that may be used to "cultivate" the soil. Given today's availability of adequate power in the form of larger horsepower tractors, there is also the possibility of extending the use of

rotary cultivation, at least in those circumstances where a fine tilth is desired or acceptable. In the subsequent sowing operation, the use of precision seeding will become the rule.

Similar developments can be anticipated in the area of harvesting and processing. Recent developments in the harvesting of forage presage far-reaching changes in that field. In particular, the briquetting, cubing, and wafering of livestock feeds will provide a higher quality product with reduced wastage and easier handling and storage than most other forms of conservation. Thus, one or the other of these techniques is destined to be found on most crop-livestock farms. For poorer quality forage, haying is likely to continue. To overcome some of the handling problems, use will be made of automatic haystacks, by which the cut material is compressed in the trailer by air-blast and is dumped and stored in the field in this moulded form.

The harvesting of cereals and other seed crops is likely to be aided by the use of electronic monitoring and automatic control on combines. In some situations, too, remote control may be used–either for combines themselves or for the bulk trailers used in carting grain from the field. At the storage base, the use of augers and elevators will become even more commonplace, and the movement of grain through pipes by air-blast or pumping devices may be introduced. The harvesting sequence will be regulated by the inclusion of an artificial-grain-drying phase, using the continuous-flow principle and probably incorporating the alternating heat-cool-heat sequence termed "dryeration", that prevents heat damage to grain.

Just as mechanical harvesting has spread from grain crops and forage to sugar cane and potatoes, so mechanical methods will increasingly spread to the harvesting of vegetables such as lettuce, to the stripping of grapes and soft fruits, and the shake-catch harvesting of tree fruits. The harvesting of all crops will be eased by improved handling methods.

Materials handling, though always significant in farm production, has tended to lag in its agricultural applications. Consequently, there is a body of materials handling and storage technology used in industry and commerce that can readily be applied to farming. Thus, we can expect to see materials handled in bulk and loosely packed, together with fork lifts and other mobile units for lifting, stacking, and transportation. In storage, there will be extended use of environment control and irradiation, and of such measures as the chilled storage of grain and the sealed conserving of high-moisture grain for livestock feed.

The livestock industries in particular can be expected to increase their level of mechanization. All buildings will feature better design for environment control –improved ventilation, odour suppression, and perhaps solar heating. Given improved fodder-processing, the relative cost of open grazing losses will soon justify "zero-grazing" policies, where the animals are kept off valuable pasture and the feed delivered to them. As feed distribution becomes mechanized so will cleaning operations and the removal of waste products. This will involve mechanical

sweeping and conveyors for handling manure, or perhaps pumps and the use of fluidization to facilitate ease of disposal. The biggest changes are likely to be in general building design and mechanization to enable efficient materials-handling methods to be used whenever possible.

Some of the more radical changes in all types of farm machinery are likely to be those relating to operation and control. With changing working conditions more design emphasis will be placed on convenience and comfort (and, hopefully, safety) in both operation and servicing. This will be facilitated by the extension of human engineering principles and research. One feature of the change will probably be the use of automatic adjustment made possible by extended use of electronic devices. Applications of this type will range from automatic irrigation control to the automatic balancing of the operation of component systems in complex machines.

Many improvements in control and comfort may derive from massive changes in the configuration of the tractor. Though some changes are already observable, such as the use of four large wheels and a centrally hinged body to permit steering by hydraulic rams, even more dramatic changes are now made feasible by the introduction of the hydrostatic transmission. This removes all advantage from the driver being mounted above the transmission, and means that he might be seated elsewhere–up front, for instance. As such changes occur, the tractor is likely to become unrecognizable in terms of its traditional appearance.

All of these changes will be accompanied by, and will to some extent necessitate, changes in machinery management. Already farm mechanization is based largely on "systems". As the individual machines that are components of an integrated system become more sophisticated, it becomes more difficult to assess and combine the many alternatives to best advantage. It is similarly difficult to develop and tailor a system so that it is adequate to the needs and purpose of a particular farm situation. Consequently there will be increased use made of "systems analysis", and the use of various optimizing techniques, to facilitate the selection and combination of mechanical equipment. Similarly, as the specification of machines is improved and the precision of the operation increased, there will be a need for greater care and accuracy in servicing and adjusting them. There will also be more care required in assessing the optimum time to replace component parts of equipment items, and the component units of machinery systems. This will again necessitate the application of developed management tools. The use of these tools will make necessary a process of evaluation to obtain relevant measurements, and the extension of information systems to permit the data to be effectively used. To a large degree, the management of machines will in future be dependent on outside sources of information rather than inside information and practical insight as at present.

Facilitation of Continued Mechanization

The mechanization of agriculture still has almost unlimited prospects. Many developments are foreseeable. Assuredly, a great many others are not. The

adjustments that will accompany this mechanization may well be as radical and far-reaching as any in the past. The adjustments of the past have caused problems and difficulties that have not been easily or fully resolved. If mechanization continues in haphazard fashion, these less desirable effects can be expected to accumulate.

Thus a program of action aimed at facilitating further progress in farm mechanization seems desirable. Such a program must influence each stage of the manufacturer-dealer-farmer relationship. It would need to take account of their tripartite involvement and shared responsibility in what is an interdependent, co-operative, chain relationship. No change in machine design can be introduced without effects on the dealer and the farmer. No adjustment in farm size can be made without its impact on the dealer and the manufacturer. No change in the organization of dealerships can be without its effects on both suppliers and clients. Yet each link in the chain has its own special responsibilities.

The manufacturers must inevitably remain the largest in size, and smallest in number, of the firms involved in the co-operative process. Their special responsibility concerns the quality of technology, both that in hand and that being developed. Progress in mechanization necessitates new and improved designs as well as changed specifications to meet the needs of the changing farm scene. Thus, it is necessary that they have a continuing program of research and development, and this is both difficult and expensive. Although all manufacturers, large and small alike, undertake some development work, the question can always be raised as to whether they do enough. Small firms producing mainly for the Canadian market can obviously spend less on research and development than larger firms. But larger firms, producing as they do for a world market, can spend only a limited amount on work directly related to Canada. Yet Canadian agriculture has many characteristic features that may justify considerable study of mechanization problems, particularly if Canada is to maintain an agriculture that can sell competitively on world markets.

The second responsibility of manufacturers concerns the maintenance and effective working of the co-operative link between themselves, their dealers, and the farmers who buy and use their products. The manufacturers have a special role in doing this partly because of the dependence that farmers put upon them, since they are the source of a basic input of farm production, and partly because of their dominant size in relation to both dealers and farmers. This responsibility covers not only the supply of equipment, but of replacement parts, finance, specialist services, and information.

This service is usually provided through the dealership. Prior to purchase, the dealership must provide information (including perhaps a demonstration), stocks to ensure availability, and finance or knowledge of how and where it can be obtained. During the transfer the dealer must facilitate the "paper war" involved in transferring ownership and arranging payment and delivery. After sales he must

provide service and other skills needed to ensure effective machine operation. In addition, he has to provide a feedback of information to the manufacturer, relating to sales, field use, warranty, stores turnover and service plans. None of this might seem very difficult, and, in practice, many dealers manage to achieve most of these things very well. In doing so, however, they are dependent on outside sources for basic skills, for information, and for buyer finance. As the level and complexity of mechanization increases, their needs in each of these spheres change accordingly. Although some of these requirements are met by dealers themselves (either individually or collectively) and some assistance is provided by manufacturers, it is questionable whether this is enough. Since education and training, information sources and extension, and credit arrangements are all outside the dealer's control, he needs purposeful assistance and co-operation from outside sources to enable him to function effectively.

The responsibility of the farmer in the progressive mechanization of agriculture includes the acquisition, finance, and utilization of machines. Thus, he has to plan his operation and select machinery to meet the needs of the over-all system he decides to implement. To do this he must use knowledge and information in conjunction with his management skills. In order to get his operation going the farmer has to acquire the equipment involved using either capital obtained from external sources or from internal capital provision by using reserves or diverting expenditure from alternative investment. Where credit is used, the flow of repayments has to be organized. Once the machinery has been obtained the farmer is confronted with the problems of its effective utilization, maintenance, and subsequent replacement. Where the program of the operation is changed (perhaps in response to product price changes, market conditions, or to farm amalgamations) there are the inevitable adjustment problems of re-mechanization. In all of these activities the farmer is dependent on outside assistance, both from the farm machinery industry through the dealerships, and from other sources.

The type of assistance needed most by farmers includes detailed information about production alternatives. For this they are largely dependent on outside services because of the nature of the farm firm. Most farms are run as family units with usually one person, or two at most, involved in management. On this scale there can be virtually none of the specialization in managerial functions existing in all large industrial or commercial firms—such as the farm machinery firms or the larger dealerships. Because of the limited size of the management input, there is a severe limitation on both the time and the skills that can be devoted to decision-making and other managerial functions. This situation has been long recognized, and its recognition has been the basic reason for the initial establishment and subsequent expansion of government-supported farm research and extension programs.

The structure of farming in Canada is, however, changing. The process of farm amalgamation seems certain to continue for many decades to come. But what is also certain is that, even if this process ensues at a very high rate, few if any farms

will achieve a scale of operations sufficient to permit the sort of management advantages that are associated with the division of functions between individuals and development of their specialist skills. This is not to say that we should not anticipate some changes in this direction. It is highly likely, for instance, that larger farms will be able to allocate some resources (more than in the past) to improving management functions, including the analysis of decision alternatives. It is also very likely that the higher cost of decision error associated with larger expenditures and more technically sophisticated operations will make it profitable to do so. Though this may lead to some changes in the nature of management on farms, with farmers themselves becoming increasingly well trained, there is also likely to be a growth in privately operated farm management consulting firms to meet the demand for both analytical skills and reliable information. This development has already begun on a small scale in Canada and is even further developed in other countries including Australia, Britain, and New Zealand. To a very large extent, however, these firms are also dependent on a supply of information from industrial firms, research centres, universities, and government agencies, on which to base their analyses and advice.

Apart from the accuracy of his decisions, the farmer has to worry about finding the capital to finance the expansion or adjustment of his business. A consideration of agricultural change in Canada over the last two decades, involving all aspects of farm structure and technology, strongly suggests that the adjustment to a more efficient agricultural pattern may be mechanization-led. Thus capital funds for the purchase of machinery may be the key to continuing farm progress. Because the purchase of new machinery requires a medium-term investment that must compete for funds with other capital requirements such as land acquisition and working capital, availability of funds may at times be a limiting factor in new machinery acquisitions. Thus there is a need for adequate credit facilities and investment incentives for the farmer.

In view of the significance of farm mechanization for future progress, and of the prevailing conditions surrounding farm machinery in Canada, it is recommended that the government should consider implementing a program to encourage farm mechanization and to smooth its advancement. Such a program should meet five requirements: (i) ensure that sufficient research and development is undertaken in relation to farm machinery in Canada to provide a continuing flow of new machinery technology well suited to Canadian requirements; (ii) provide facilities for measurement and evaluation activity so that adequate reliable information is available to ensure the successful introduction and efficient use of new farm machinery; (iii) endeavour to promote the smooth functioning of a co-operative relationship between manufacturers, distributors, and users of farm machinery; (iv) attempt to minimize the adverse effects of mechanization on health, safety, and welfare of the agricultural community, and (v) provide credit facilities and capital-formation incentives to encourage an adequate rate of investment in farm mechanization.

Each of these requirements might individually be achieved in any of several different ways. Since they are interrelated aims, however, they might best be achieved by one integrated program, rather than a number of isolated ones. Similarly, where there are institutions that can effectively cope with some aspect of these requirements, no new institutional arrangements should be considered necessary. In this regard, the area of machinery finance seems well served by the existing system and no major changes seem necessary. Thus recommendations concerning farm mechanization are as follows:

1. Research and Development – In an earlier section of this Report (Chapter 17) it was pointed out that the benefits that had been derived from improvements in farm machinery technology in the past were extremely large. Indeed, over the period from 1926-66 it was estimated that the net benefits obtained were probably of the order of from \$2 to \$3 billion annually and might well exceed those derived from all other agricultural improvements. If it could be anticipated that future benefits would be in proportion to past benefits, a case could be made for allocating as much as one-half of all the government's expenditures on agricultural research to the improvement of farm machinery technology. However, such a massive reallocation of the R&D effort related to agriculture could not take place overnight. Accordingly, it was recommended that the Canada Department of Agriculture set as its short-term goal to be reached by 1980 the allocation of 10 per cent of its total research budget to supporting improvements in farm machinery. By 1985 this allocation should be raised to 15 per cent. On the basis of the present research budget, this would imply an annual expenditure of around \$4 million by 1980, and \$6 million by 1985. Some additional funds should be provided to support the expansion of capital facilities required for an effective research effort. After this goal has been reached, the value of further reallocations towards research on farm machinery technology should be carefully considered before any further goals are established. Reaching this goal need not require a net over-all increase in government spending, since there may be many other areas of government expenditure where potential benefits are very much lower than those for research on farm machinery technology.

A number of guidelines the government might follow in expanding its research program were suggested earlier and these are repeated here. Considerable emphasis should be placed on expanding basic knowledge about farm machinery technology, especially with respect to machines suited to the type of soil, climatic and crop conditions prevalent in Canada. A substantial part of the increased research funds should be allocated to support farm machinery research programs in Canadian universities. There should also be an expanded research effort at the federal government's research stations and experimental farms. While there is undoubted merit in giving individual research workers considerable freedom in choosing their research projects, an effort should be made to allocate funds in proportion to potential benefits. Potential benefits are, of course, difficult to estimate with accuracy. For this reason, some reliance may have to be placed on

fairly crude guidelines such as the value of crops for which the machinery is used or the potential for further replacement of labour. Still, it should always be remembered that potential benefit is the appropriate measure.

A central body should be established to oversee and co-ordinate the use of these funds so they can best meet the future needs of agriculture across the country. To exercise this role effectively, this central body should have a modest research effort of its own to keep it in close contact with research problems in this area. It should also maintain effective liaison with the R&D efforts of the private machinery firms. The governing board of this institution should include representatives from provincial and federal governments, from the farming community, industry and the universities, and should include engineers, agricultural economists, plant scientists, and representatives of other disciplines. While it is not intended to provide a detailed blueprint for such a board, the following might provide an acceptable pattern: university representatives 3, provincial governments 2, federal government 2, manufacturers 3, dealers 2, and farmers 3. The governing board should also include the director of the central research station and perhaps two of his senior staff members.

As was noted earlier many new inventions or ideas for improvement in farm machinery originate with farmers. Typically the farmer has little knowledge of how to patent or market his invention. It is recommended that the research unit described above should be prepared to provide farmers with advice on how to patent their improvements in farm machinery and on how to market them.

2. Evaluation and Information – With the growing complexity of farm machines and the increasing pace of technological change, farmers' decisions about what machinery to buy–in what sizes and types and with what attachments–have become more difficult. Yet with the higher capital costs involved in modern farming, the importance of correct decisions has increased. More information is needed if the farmer is to make intelligent and economic decisions.

The information can come from a number of sources. The manufacturer obtains a good deal of information in the process of developing and testing new machines. Additional information becomes available to the manufacturers from their records with respect to warranty and provision of repair parts and from the analyses they make on the causes of component failure. With the test facilities they have available they could easily record additional data if it seemed desirable. Some data may be recorded on the way machines perform in use on experimental farms or university field stations. Farmers also acquire information about the performance of the machines they buy and use. This could be collected and made more generally available. In some important areas there is surprisingly little information available at any level. For example, data on the working speeds of tillage machinery and the efficiency of machinery at these different speeds is surprisingly hard to obtain.

Recently the larger manufacturers have begun to make use of systems analysis, first applied in the defence, aircraft, and space industries, in the design and

development of new machinery. This approach has been used with some success in upgrading the reliability of machinery with a resultant saving both to the manufacturer and the farmer in the form of lower warranty costs and improved reliability in operation.

Although the manufacturer of farm machines has recognized the systems approach in developing new machines, he has yet to recognize that the machine he manufactures is only part of a larger system including the farmer. Little provision is made for providing the farmer with the kinds of information he needs to make intelligent buying and replacement decisions. Increasingly sophisticated analytical tools are now available to farmers to help make decisions about machinery purchase and use. Yet very few of the measurements recorded by manufacturers are accessible to farmers and, in general, the data they can obtain are quite inadequate to permit effective use of the available tools. How can this deficiency be overcome?

Official testing agencies for farm machinery currently exist in some 29 different countries including Australia, Britain, Finland, France, Germany, Italy, The Netherlands, Sweden, and the U.S.S.R. No such agency exists in Canada, although for several years the Agricultural Machinery Administration operated by the Saskatchewan government conducted a testing program. In the United States the University of Nebraska operates a tractor-testing program whose tests are compulsory for all tractors sold in the state. In fact, almost all the tractors sold in the United States are tested at Nebraska. The Commissioner visited testing stations in a number of European countries and discussed their programs with the officials responsible. In addition, a careful examination of the many issues involved in farm machinery evaluation is provided in one of the Commission's separate publications.[1] The issue of farm machinery testing or evaluation was also discussed extensively during the Commission's public hearings. It received almost uniform support from farmers and farm organizations. In contrast, manufacturers appeared rather fearful of what might be involved, and argued that since their own test programs were adequate any additional government testing was unnecessary. They scarcely seemed aware of the farmer's need for additional information. On the basis of this extensive review of the matter the following recommendations are made:

(i) The federal government should establish a central agency for the testing and evaluation of farm machinery. The agency should set up such regional stations as appear desirable for an effective program. Although the testing agency would have its own budget and manager, both the testing agency and the research organization would be under the supervision of one senior officer (a president or chairman) and through him to the same governing board.

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[1] G. F. Donaldson, *Farm Machinery Testing,* Royal Commission on Farm Machinery, Study No. 8 (Ottawa: Queen's Printer, 1970).

(ii) The basic goal of the testing agency should be to provide farmers with the kind of information they need to make intelligent decisions in buying and replacing farm machinery. The agency will undoubtedly want to approach its job on a flexible basis. For some machines, the most effective way to provide information may be to devise a set of standard tests which all manufacturers would be required to carry out and publish as a condition for selling their machines. For other machines, the agency may wish to conduct its own tests. A certain amount of in-house testing will be needed to validate and improve the standard test procedures. It may find it desirable to collect information from farmers, on a sample basis, with respect to the operating characteristics of some machines. With such an experimental and wide ranging approach the agency should, in time, discover how to discharge its role most effectively.

(iii) The agency should offer to test prototype machines for manufacturers for a modest fee. The experience of other countries suggests that a service of this kind often produces significant improvements in machines before they are marketed. Such a service might also help smaller firms to keep their machines competitive in quality with those of the larger firms. The mere existence of a testing agency may serve a useful role since it will deter manufacturers from rushing machines to the market before they have been fully tested. The knowledge that deficiencies may be exposed in a government test report can provide a salutary check on the temptation to short-circuit the testing process.

(iv) The size of the testing program is to some degree a matter of judgement. It is recommended that the agency should initially be provided with an operating budget of $1 million. At current wage and salary levels this should enable the agency to employ about 20 scientists and support them with secretarial, technical and other assistance. Budgetary provision would need to be made also for any required capital facilities.

On any assessment of potential benefits, such an expenditure would appear to be fully justified. If better information enabled farmers to save 5 per cent on tractor fuel consumption, the saving would amount to $30 per farm each year. Another $25 per farm might be saved by effecting a 5 per cent saving on repair costs. A further saving, say $45 per farm, might be obtained through better selection of machine size. On the basis of 300,000 commercial farms, a saving of this magnitude would provide an annual saving of $30 million. Even one-tenth of this would be $3 million per year. The total operating budget proposed here for the test agency is less than one quarter of 1 per cent of the farming industry's annual expenditure on new machinery and repair parts. Compared to the amount that other

industries often spend on assessing new investment projects, the amount proposed is very small indeed. For this reason, after a number of years of operating experience, it may be desirable to increase the agency's operating budget to perhaps twice the amount proposed above.

(v) The agency should take whatever steps it deems desirable to ensure that the information it obtains from its tests and in other ways is made available in usable form to the farming community. In this connection, the provincial governments and universities may wish to reassess their advisory service to farmers in order to make sure that they can effectively take advantage of the new information that will be provided by the test and evaluation agency. In this connection it may be helpful to give a comment on the state of affairs in the United Kingdom to the effect that:

> Until recently the number of products of the engineering industry on farms was very limited. During the last 20 years they have multiplied considerably but they will multiply very much more quickly in sophistication and in numbers in the coming decades. However, we still train farmers and advisory officers as if engineering was a trifling part of their future responsibilities. One of the things that is urgently needed in the United Kingdom is a reorientation of education for farm owners, managers and advisory officers. Engineering must take its place as one of the important aspects of their training.

The same may very well apply to Canada.

(vi) The agency should seek the co-operation of existing advisory services and should support them wherever possible.

3. *Co-operative Relationships* – With farm machines now so important in agriculture, it is highly desirable that all those involved in the supply and use of farm machinery maintain an effective working relationship. This is most likely to be realized where there is good communication on a two- or three-way basis between the farmer, the dealer, and the manufacturer. Too often in the past these relationships have been complicated by various suspicions and a general lack of understanding of the problems faced by other members of this tripartite group. There is reason to believe that the Commission's public hearings performed a valuable role just by enabling farmers, dealers, and manufacturers each to achieve a better understanding of the problems faced by other members of the group. However, the improved understanding obtained in this way may deteriorate in time. For this reason the following two recommendations are made:

(i) Under the general supervision of the governing board proposed above, a small unit should be established whose major role should be to use its "good offices" to help maintain a good working relationship among all those involved with farm machinery.

(ii) It is recommended that each of the provincial governments designate some person with a good knowledge of farm machinery problems to act as an "ombudsman" in this area. He could hear complaints from farmers, or dealers or even manufacturers who felt they had been unfairly treated, investigate them thoroughly and try to achieve a just settlement of the problem. Some provinces already have a person who performs this role. It is desirable that the practice become more general and that all farmers be aware of its existence.

4. Safety and Health — As a study already published by the Commission indicates, farm machinery can have very adverse effects on the safety and health of farmers.[2] Within the past 10 years the fatality rate in farm machinery accidents has more than doubled. In addition, many farmers have been injured more or less seriously and suffered pain and shock and in some instances permanent injury and have incurred medical and hospitalization costs and a loss of working time. Even apart from accidents, there is evidence that farmers suffer significant loss of hearing and other adverse effects from continuous use of large power machinery. Anything that can be done to reduce or minimize these effects will add significantly to the farmer's welfare. The following recommendations are made with these considerations in mind:

(i) Roll-bars with seat belts or safety cabs should be compulsory on all new farm tractors sold in Canada. Within a short time, the requirement should be extended to all tractors. Cabs that do not meet safety specifications should be outlawed for use on farms. The regulation would need to be established in terms of cabs or roll-bars that meet certain minimum engineering standards. The standard currently in effect in Britain and Sweden may prove suitable. Roll-bars now are available as optional equipment from many manufacturers. However, the prices currently being charged appear inordinately high. The Commission obtained from a prominent engineering firm an estimate of the manufacturing cost of the roll-bars currently sold by a major farm machinery firm. According to their estimate, the manufacturing cost is only from 20 to 25 per cent of the manufacturer's suggested retail price. Prices for other firms were roughly comparable. Thus, in introducing this provision, it is desirable that there be sufficient advance notice to allow short-line and other manufacturers to enter this market and keep the price at reasonable levels. Swedish experience suggests that the use of safety cabs or roll-bars on tractors could be expected to reduce the fatality rate from farm machinery accidents by 50 per cent and save some 60 to 70 lives a year.

(ii) The government should sponsor a program of research designed to improve the safety and reduce the health hazards connected with farm

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[2] G. F. Donaldson, *Farm Machinery Safety*, Royal Commission on Farm Machinery, Study No. 1 (Ottawa: Queen's Printer, 1968).

machinery. Specifically, the unit or agency charged with this responsibility should study and possibly make recommendations with respect to the compulsory use of a further range of safety devices including: driving and warning lights, rear-view mirrors, slow-moving vehicle emblems, passenger seats or safety hand grips on tractors, additional brakes, maximum noise emission levels, guards and safety shields. Funds should also be available to encourage research in universities into the safety and health hazards connected with the use of farm machinery.

(iii) The same unit or agency should take the responsibility for initiating an improved program of education on the health and safety hazards related to farm machinery as well as an improved set of statistical data in this area.

5. *Adjustment Problems* – Over the past few decades the introduction of improved farm machinery has had far-reaching effects on the rural scene. More than any other factor, it has been improved farm machinery that has caused the farm labour force and the farm population to decline by more than one-half since 1945. These improvements are also an underlying causal force behind the decline in the number of farm machinery dealerships and the concentration of sales in a smaller number of much larger dealers. Again, it is improved machinery that has led to the shift to larger farming units and concurrently to the decline in smaller trading centres and the concentration of an increasing proportion of sales in larger centres. And with the many further improvements in machinery that are still on the horizon there is every indication that these trends will continue.

Until recently, the farmers who were forced or induced to leave farming by these underlying forces had to find an alternative occupation and re-establish themselves and their families with little outside assistance. Indeed, governments often scarcely seemed aware of what was happening. The programs for retraining and relocation introduced by the Department of Manpower and Immigration within the past few years have done much to change this picture. Still, people in rural communities may often be unaware of the assistance that is potentially available. For this reason there should be a small research program designed to keep a continuing watch over this problem. Society as a whole and some farmers receive substantial benefits from the improvements in farm machinery technology that are continuously being introduced. It is only fair that the social costs and undesirable side effects that progress imposes, often on the older and less well educated members of the community, should be eased by suitable government measures. The research program envisaged would be small, perhaps consisting of two agricultural economists and two rural sociologists. It might well be located within the research division of the Canada Department of Agriculture.

6. *Credit Facilities and Investment Incentives* – There can be little doubt that the Farm Improvement Loans Act has done much to make funds available at a

reasonable cost for the finance of farm machinery. Still, there are a number of considerations which suggest that some further encouragement is needed for investment in farm machinery. First, there is the evidence, cited earlier, that investment in farm machinery often yields large returns. Farmers, in effect, under-invest rather than over-invest in farm machinery. Second, investment in new farm machines is often the key element in encouraging the shift to a more efficient size of farm enterprise. Third, new machinery may often be a vital link leading to the adoption of improved farm technology in general. All this suggests a need for reassessing the incentives provided for investment in farm machinery.

A key question is the adequacy of the allowances for depreciation. For income tax purposes, farmers are allowed, if they prefer, to use the straight-line method of charging depreciation instead of the more usual and the more economically suitable declining balance method. The rates in effect under each method for a recent year (1969) are as follows:

	Straight Line	Declining Balance
	(Per cent)	
Combines, hay balers and forage harvesters:		
pull type	10	20
self-propelled	15	30
Sprayers	10	20
Tractors	15	30

Using these rates a new tractor or self-propelled combine would be depreciated to about one-third of its purchase price within three years using a declining balance method. If allowance is made for the degree to which list prices exceed the effective value of new machines—17.5 per cent on the average—this one-third comes closer to 20 per cent. This seems entirely adequate. On the other hand, the straight-line rates appear low and might well be increased from 10 to 15 and from 15 to 20 per cent.

Allowing farmers to depreciate their machinery on the basis of a list price, which is usually some 15 to 20 per cent in excess of the effective price paid by the farmer, is largely equivalent to giving farmers an investment credit, a device which allows charging to depreciation, for tax purposes, an amount in excess of the purchase price. In view of the desirability of maintaining a strong incentive for investment in new machinery this advantage to farmers should be retained. However, it might be preferable to rationalize present practice by giving farmers a straightforward investment credit on new machinery purchases.

To sum up, the proposal set forth above calls for a Farm Machinery Institute with two major divisions each with its own manager and each responsible through a senior officer (president or chairman) to a semi-independent governing board. The National Research Council might be an appropriate model to follow in developing

the Institute's structure. One division of the Institute would be primarily concerned with research, and might well be assigned the responsibility for safety and health problems. The other division would be primarily concerned with the testing and evaluation of farm machinery and the provision of better information to farmers to support their machinery purchase and replacement decisions. It could also be assigned responsibility for maintaining good channels of communication among the various groups involved in the farm machinery problem as recommended above under the heading of co-operative relationships. The manager and one of the senior officers of each division and the President or Chairman of the Institute should be members of the governing board. Beyond this, the membership of the board should represent the various groups involved, including governments and the university community.

Most of the machinery used on Canadian farms is produced by a few very large companies, several of them ranking among the 20 largest corporations in the world, and nearly all of them having their head office outside Canada. If the Farm Machinery Institute is to be able to intervene in the relationship between these firms and their dealers and farmer clients using only its "good offices", it will need to be making a continuing positive contribution of its own. I am confident that with the structure and budgetary support proposed, the Institute should have no difficulty in doing so.

PART V

SPECIAL PROBLEMS AND ISSUES

Chapter 27

THE REPAIR PARTS PROBLEM

During the course of its public hearings, the Commission was impressed by the number and strength of the complaints registered by individual farmers and farm organizations about the difficulties farmers were having in getting a quick and reliable repair parts service. The feeling appeared general that manufacturers should be able to provide a better service than currently existed, especially by stocking more parts at the dealer and branch level. The very great importance attached to this matter by farmers undoubtedly reflects the fact that a few days' delay in getting a major piece of farm equipment back into operation during a busy season can involve the farmer in very serious losses.

To help it assess the nature and dimensions of this problem, the Commission carried out two surveys. The first of these surveys, carried out in November 1967, was confined to four major provinces—Ontario, Manitoba, Saskatchewan, and Alberta—and asked farmers to report any specific problems they had experienced in obtaining repair parts or service for their machinery in the period since April 1966. Farmers who reported specific problems were then asked to report in some detail on the nature of the problem, the machine, dealer, and company involved, and to answer a number of related questions designed to throw some light on how or why the problem had developed. This questionnaire was distributed through the co-operation of farm organizations in each of the provinces. One of the major purposes of the questionnaire was to provide a basis for selecting what appeared to be typical problems which could then be followed up in detail by interviewing the farmer, dealer, and company involved. It was limited to problems occurring since April 1966 in the hope that records about the complaint would be available.

The second survey in January 1968 involved the distribution of a shorter questionnaire to a carefully selected sample of farmers across Canada. This questionnaire was designed to provide an over-all view of the extent and seriousness of the repair part and service problems faced by farmers.

In the first survey, some 50,000 questionnaire forms were distributed and of these 7,259 or about 15 per cent of the total were returned. About 22 per cent of the forms returned reported a repair part or service problem. Although complaints

were made involving some 78 different kinds of equipment, a major part of the complaints, some 43 per cent, involved the tractor. Other machines frequently involved were the combine (24 per cent), the swather (6.5 per cent), the baler (3.8 per cent), the disker (2.3 per cent), and the forage harvester (1.9 per cent). When the number of complaints was compared with the number of implements of each type on farms, it became clear that in terms of numbers in use, the combine was the cause of more trouble than any other machine. This may well reflect the complexity of the machine and its large number of working parts.

In the more detailed follow-up to this survey, 20 typical complaints were chosen for each of the four provinces and an interviewer for the Commission talked to farmers, dealers and, where necessary, company personnel in order to determine the circumstances surrounding each complaint. The interviewers were all provincial residents who had a good background in farming and possessed at least two years of university education in agriculture or agricultural engineering. The farmer interviews were carried out just after harvesting had been completed, when the farmer would have time to discuss his problem, but when it would still be fresh in his mind.

In order to ensure some uniformity, the Commission's representative in each of the four provinces was provided with questionnaire guides to use in his interviews with farmers and dealers. Both farmers and dealers were classified by size and given a rating ranging from excellent to poor. The farm size was considered small if less than 250 acres, medium if it was 250 to 750 acres, and large if over 750 acres. The farmer's rating was based on his attitude, the condition of his repair-shop facilities, and other related indicators. Dealers were rated as small if annual sales were less than $250,000, medium were sales ranged from $250,000 to $500,000, and large if sales exceeded $500,000. The dealer's rating was based on the quality of his premises, records, order follow-up system, relationship with branch, and similar indicators. In each case, a rating on the dealer was made before the interviewer attempted to assess the circumstances surrounding the specific complaint.

In the 80 cases that were studied in detail, the complaint in a great majority of cases was that the farmer had been unable to get repair parts promptly when he needed them. Although some short-line companies were involved, the great majority of complaints (85 per cent) involved full-line or long-line companies.

Perhaps the most significant finding of this in-depth study was that the dealer was wholly or partly to blame in about one-half of all cases. Typical comments by the interviewer in these instances were: wrong part ordered by dealer, dealer did not follow-up back order, dealer failed to order parts, dealer slow in ordering, dealer failed to notify farmer that parts had been received. Moreover, when the instances of complaints involving dealers were analyzed it was apparent that a significant number of the complaints were caused by dealers who were small or who received a relatively low rating, or both. Thus of the 40 complaints where dealers

were judged by the interviewer as being wholly or partly to blame, some 28 were given over-all ratings of fair or poor and these ratings were made before the complaint was investigated.

Dealers Partly or Solely to Blame

Dealer Ratings		Dealer Size	
A (Excellent)	3	Large	10
B (Good)	9	Medium	10
C (Fair)	18	Small	19
D (Poor)	10	Not stated	1

Some 19 of the dealers at fault were small dealers. Although farmers are generally reluctant to blame dealers for their difficulty in getting adequate repair parts service, it is evident that a general upgrading of dealers would help reduce the incidence of repair parts and other service problems.

In some 44 cases the interviewer assessed the company or its branch to be primarily to blame for the difficulty. In more than one-third of these cases, the reported fault was simply that the part was not available when it was required. The remaining two-thirds covered a wide variety of causes. Aside from parts being out of stock, the most frequent complaint was that the machine was poorly designed or had not been adequately tested. Other comments included: implement was shipped with wrong size parts, poor records kept at branch, company sent wrong machine, branch parts depot closed on weekends, delay of shipment at branch depot, wrong part sent by branch. In five of the 80 cases examined, the farmer was judged to have no valid complaint, and in an additional seven instances he was considered to be partially at fault.

In the national questionnaire survey, some 69,000 survey forms were mailed out and over 55 per cent of these were returned, an extremely high response for a mail survey. Moreover, some 48 per cent of those responding reported that they had experienced some difficulty in securing repair parts during the previous two years. Some 30 per cent of these—or just over 14 per cent of all farmers who returned the form—felt that they had experienced a major repair part problem in this two-year period. An additional 46 per cent, or about 22 per cent of those responding, reported a repair parts problem they considered of moderate severity. Thus the national questionnaire indicated a significantly higher proportion of farmers experiencing repair parts difficulties than was shown on the earlier survey confined to four major provinces. While it has not been possible to reconcile these two results, it seems likely that because the first survey was longer and more difficult to complete, it would only be completed, for the most part, by farmers who considered their problem fairly serious. Thus the 22 per cent of those farmers who reported a repair parts or service problem on the earlier survey can be compared with the 14 per cent who reported a serious repair parts problem in the national survey.

In the latter survey, farmers were also asked to express their views about changes in the quality of machinery, the service provided by dealers, and the frequency of model changes. Some 44 per cent of the farmers who responded felt that the quality of machinery had improved in the last ten years and an additional 25 per cent felt there had been little change. Only 24 per cent felt that quality had declined. In contrast, when asked whether the service provided by farm machinery dealers was better or worse than ten years earlier, only about 20 per cent expressed the view that service today was better, 49 per cent felt there had been little change, and 25 per cent said the service had deteriorated. The great majority of farmers, some 74 per cent, thought that model changes occurred too frequently. In the same survey, 19 per cent of all farmers said they had experienced problems in adjusting their machines to their farm requirements. About 25 per cent reported that a company representative had called at their farm to assist with equipment.

In both surveys, some attempt was made to determine the extent to which the farmers' care and maintenance of their machinery may have contributed to some of their problems, but the results were rather inconclusive. In the national survey, over 70 per cent of the farmers said they normally gave their machines a major pre-season overhaul, and about half of the farmers reporting said they had their own repair shop. Similarly, in the detailed follow-up of a small sample of problems in four provinces, the great majority of these farmers said they had a preventive maintenance program to which they regularly adhered. Further, almost one-half of these farmers said they did part or all of their own repair work (with the exception of major repair or overhaul work on engines or transmissions), yet a majority of these farmers indicated that neither they nor their hired help had had formal training as mechanics. Thus, attempts by farmers to overhaul and repair their own machines without any formal training in mechanics may contribute to the subsequent problems that develop. About 80 per cent of this group of farmers said they stocked at least some fast moving parts on their farm and about 85 per cent felt that they had good relations with their dealer.

Some additional information on the problem of maintaining and repairing farm machinery was provided by a survey of farmers in Saskatchewan carried out by the Saskatchewan Wheat Pool.[1] For the most part this survey was completed by local Pool Committee chairmen. However, about 15 per cent of the returns were from non-Pool farmers contacted by local delegates. The results for these two groups in most instances were not significantly different.

The introduction of diesel engines, the finer tolerances on modern machinery, and rapid changes in models, it was suggested, had increased the farmers, dependence on dealer servicing. In addition, the increasing use of sub-assemblies that had to be replaced as a unit meant that more often a machine had to be shut down until a replacement assembly was available. While over half of the survey

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[1] Saskatchewan Wheat Pool, *Brief to the Royal Commission on Farm Machinery*, Regina, March 28, 1967.

respondents had no education beyond public school, some 57 per cent said they had received some training in motor mechanics, welding, and similar skills useful in machine repair. Just over half said they had a well-equipped workshop, and about the same proportion reported that they had spent more than $500 for repairs (including labour costs) during 1966. In a question about the number of days a machine was out of use because of a breakdown during 1966, 37 per cent of all farmers reported they lost one day or less, 54 per cent reported a loss of one to six days, 9 per cent seven days or more, and about 2 per cent fourteen days or more. In many of these longer delays, farmers were able to continue their work with replacement machines borrowed from a dealer or neighbour. Some 72 per cent of all reporting farmers stated that their nearest stock of repair parts was within 20 miles, yet the same percentage stated they would be willing to travel over 20 miles (45 per cent said over 30 miles) for repair parts if reasonably sure of getting them on arrival. Farmers in Saskatchewan may, of course, be used to travelling longer distances than is true in many other parts of Canada. Still, this evidence suggests that farmers would accept larger and fewer dealers than the current pattern of distribution provides.

Numerous suggestions were made to the Commission as to how the companies might improve their parts service. These varied from the simple proposal that more parts be stocked—especially at the dealer and branch level—to the more complex proposal that companies set up on some co-operative basis a central distribution system for machinery parts. This latter proposal was also recommended in the Report of the Special Committee on Farm Income in Ontario:[2]

> Our Committee recommends as a first step, a central warehousing system for machinery parts should be established by these companies themselves. These central warehouses could improve the system of parts distribution by carrying large stocks of parts and making as many parts as possible interchangeable between different types and makes of machine, through cross-indexing these parts. Warehouses should be located at a number of strategic points in the province and they should be open for long hours during the planting and harvest rush periods. Since the warehouses would stock parts for all companies it should be possible to operate a parts service with fewer people than the total number employed by individual machinery companies at present. Regular delivery schedules could also be set up to provide a much improved parts delivery service to both dealers and farmers.

Before attempting to evaluate such a proposal it is useful to examine the nature of the part-distribution problem faced by the major manufacturers.

At the present time each of the major manufacturers faces the necessity of stocking a very large number of different parts, most of which may have very few sales in any one year. Moreover, the number of different parts in stock has been increasing fairly rapidly as new and more complex models and machines are put on the market. Massey-Ferguson reported that the number of different parts in its

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[2]Special Committee on Farm Income, *The Challenge of Abundance,* Report of the Special Committee on Farm Income, Toronto, January 6, 1969.

North American parts stock had increased from about 68,000 in 1958 to more than 100,000 in 1967. Of this total, 30,000 individual parts had no sales whatever in 1966. Similarly, International Harvester of Canada reported that the number of different parts stocked by its parent company had increased from 110,000 to 150,000 over the past decade. Of the 54,000 International Harvester farm machinery parts stocked in Canada, nearly one-half were ordered only once or not at all in the previous year. International also reported that about 60 per cent of the parts numbers in stock were for machines no longer in production. Massey-Ferguson reported that tractor and combine parts are stocked for a minimum of 15 years after the company has stopped manufacturing a machine, and that parts were still available for several machines that had been out of production for more than 20 years.

Some indication of the complexity of the parts supply problem in the farm machinery industry is provided by the data in Table 27.1, showing Massey-Ferguson's inventory and sales of parts in North America during 1966. In that year the company sold some 32 million separate parts for an annual sales value of $22.6 million, and held in inventory parts valued at $23 million. Individual parts with annual sales of fifty or more accounted for 91 per cent of the total value of parts sales, but made up only 23 per cent of the total number of parts in inventory. Over half of all the parts in stock either had no sales at all in 1966 or had sales of nine units or less throughout North America.

TABLE 27.1–ANALYSIS OF MASSEY-FERGUSON'S NORTH AMERICAN PARTS OPERATION, 1966

Annual Sales of Each Part	Number of Different Parts Stocked	Annual Sales	Value of Inventory	Annual Carrying Cost[1] Amount	Annual Carrying Cost[1] As Percentage of Sales
		($'000)	($'000)	($'000)	
0	30,007	–	1,240	186	–
1 – 9	27,979	497	2,460	369	74.3
10 – 49	18,396	1,470	3,500	525	35.7
50 – 299	13,505	4,226	5,060	759	18.0
300 and over	8,912	16,408	10,695	1,604	9.8
Total	98,799	22,601	22,955	3,443	15.0

[1] Estimated at 15 per cent of value of inventory.

Source: Massey-Ferguson Industries Limited, *Brief to the Royal Commission on Farm Machinery*, Vol. II, Ch. VIII, Toronto, October 6, 1967.

Table 27.1 also provides some indication of the relatively high cost of carrying the slower moving parts. Assuming, as was reported by a number of different companies, that the annual cost of carrying parts amounts to 15 per cent of their inventory value, it can be estimated that carrying charges on parts that sold only one to nine units annually amounted to some 74 per cent of the total value of

annual sales of these parts. Indeed, the annual carrying cost for the 77 per cent of all parts that sold fewer than fifty units in 1966 would amount to some 55 per cent of the value of annual sales.

Nor can it be assumed that the companies are able to carry all their slow moving parts in a central warehouse and confine stocks at their regional branch houses to the faster moving parts. International Harvester reported the following distribution of parts for which no orders were received in 1966:

Depot	Total Number of Part Numbers Stocked	Part Numbers with No Order, 1966	Part Numbers Having No Orders as Percentage of Total Inventory of Part Numbers Stocked	
			In Terms of Value	In Terms of Part Numbers
Burlington	54,314	17,496	13.7	32.2
Edmonton	29,579	8,499	11.7	28.8
Montreal	17,866	3,827	10.0	21.4
Winnipeg	27,501	6,917	11.0	25.2

It is significant that the no-order parts held at the branch depots at Edmonton, Montreal, and Winnipeg in 1966 were not appreciably smaller either as a percentage of the total number of parts in stock or as a percentage of the total value of parts inventory than was true for the central parts depot maintained at Burlington. A number of companies reported that the parts supply problem is complicated by the fact that there is a significant element of unpredictability in the demand pattern for different parts. Unusual weather or crop conditions may suddenly produce a heavy demand for a part whose sales are ordinarily fairly small.

Given the characteristics of the repair parts supply problem faced by the manufacturers, the very large number of different parts that must be stocked, the large number of parts for which annual sales are very small, the substantial cost involved in carrying a parts inventory, and the existence of unpredictable variations in demand for individual parts, it is clear that the companies face a difficult problem in deciding where and in what volume different parts should be stocked. For example, if Massey-Ferguson were to double the stock it carries of all parts which sold less than fifty pieces in 1966, it would require a $7.2 million addition to the company's total parts inventory. Estimating the annual cost of interest, storage, and maintenance at 15 per cent, the annual carrying charges would amount to about $1 million. While this is only a little over 4 per cent of the company's total parts sales, it would represent 55 per cent of the annual sales of this category of parts. It is clear that each company has to decide on how best to balance the cost of additional stock against the advantage they derive from their ability to supply emergency parts when needed. Since farmers place a strong emphasis on their ability to get service parts promptly when they need them, all the companies have a competitive interest in meeting this demand.

Evidence presented to the Commission suggests that most or all of the important farm machinery manufacturers have been making a concerted effort to improve the quality of their repair parts service over the past few years. Extensive use now is being made of computers to keep an accurate record of parts availability, and to ensure that parts are reordered promptly when the stock of a particular part begins to decline more rapidly than expected. Aside from difficulties that develop when new systems are being installed, it is predicted that computer control will enable the companies to provide much better service, and in many cases it is already doing so. Massey-Ferguson reported that before it installed computer control in 1958 only about 85 per cent of orders from dealers were filled from the nearest warehouse. By 1966 this level had risen to 94 per cent. During the Commission's hearings a representative of John Deere said that the company's records indicated "a tremendous improvement in the supply and transportation of parts in the last few years". Whether judged by the availability of parts at the factory, the depot, or the dealer level, he contended that the records showed this improvement. This was true, even though at that time Deere's Canadian parts records had not been computerized.

Many of the farm machinery companies have also been making efforts to improve the quality of the parts service their dealers provide. The dealers are individual businessmen and make their own decisions with respect to how many parts to stock. However, the companies can strongly influence these decisions and they apparently have been doing so. A number of companies described in some detail the guidance they provided to their dealers in the way of systematic stock records and formulas to follow in stocking parts. In addition, almost all the companies offer special incentives to dealers to induce them to stock up on fast moving parts in advance of the regular season of use. A number of companies also reported special arrangements for the return of parts designed to reduce the dealer's risk in stocking parts. Despite these efforts, it is clear from the Commission's survey that there is still substantial room for further improvement in the quality and capability of dealers. It would appear that all the companies have a very major interest in eliminating many of their smaller and weaker dealers and in continuing their efforts to improve the service provided by the remainder.

Many farmers and farm organizations have suggested that the dealer should carry more parts. It seems very doubtful that this proposal offers much hope for improving the parts supply problem. Consider for a moment the data provided by Massey-Ferguson on its North American parts operation. In 1966, the company had 2,643 dealers in North America. The company stocked just under 99,000 different parts, but of this total there were only 1,561 parts which had annual sales of 3,000 units or more. Thus, if individual dealers stocked all parts for which on the average annual sales were 1.1 units or more per dealer, they would only stock these 1,561 parts, less than 2 per cent of all the different parts in inventory. On the other hand, where a dealer stocks parts that have average annual sales of one unit or less, he runs the risk that some of these parts will become obsolete and never sell. Overall, this would substantially increase the cost of stocking and supplying repair parts.

Similarly, another company, John Deere Limited, informed the Commission that, if a dealer were to stock sufficient parts to fill his orders on an "over the counter" basis, more than 90 per cent of the time he would need to stock about 6,500 different parts. On the basis of Massey-Ferguson's data this would include about 2,500 parts that had annual sales in 1966 of from 500 to 1,000 units each, or about one sale of each part for each three to five dealers.

For the slower moving parts, this analysis suggests that the most economical approach is to stock parts in a central location and rely on rapid communication and transportation to get the parts to the farmer who needs them. As dealers get larger in size, each one will be able to stock a larger number of parts. For example, if Massey-Ferguson were able to reduce its total number of dealers to 1,000 for all of North America, the rule-of-thumb of having dealers stock all parts where average sales per dealer were one or more would add an additional 2,353 parts to each dealer's inventory. Offsetting this would be the longer distance each farmer had to travel to obtain parts. However, many farmers stated in their briefs or during the Commission's hearings that they were willing to travel further to obtain parts provided they could be sure of obtaining them when they arrived.

On the basis of this assessment of the repair parts problem, what conclusions should be drawn with respect to the proposal that the companies should set up a central parts warehouse? In this Commission's view any possible advantages of such a scheme are greatly outweighed by its disadvantages. Under present arrangements, where each company is responsible for its own parts distribution, it is quite clear where the responsibility for any failure to supply parts must lie. Since each company's reputation depends in part on its ability to offer a prompt and reliable parts service, it has a strong incentive to develop and maintain a good service. If parts were supplied through a central co-operative warehouse, the lines of responsibility would be much less clear. It is at least possible that the service under such an arrangement might deteriorate very seriously. Further, the service now provided by each company is fully integrated with the parent company's entire North American parts operation. Bringing all the company's Canadian central warehouses together under one roof might disrupt the direct lines of communication and responsibility that now exist.

The central and branch depots are already very substantial in size. For example, International Harvester's Parts Depot at Burlington, Ontario, employs 248 people and encompasses an area of 230,000 square feet. There would appear to be no obvious advantages in bringing together a number of warehouses of this size. Moreover, as is true for International Harvester, the parts warehouses of a number of companies may supply parts for automobiles, trucks, and construction equipment as well as for farm machinery.

A greater saving would be available from a central warehousing operation if there were a large degree of inter-changeability among different companies' parts. Except for a few parts such as bearings, where all companies have common suppliers, very little inter-changeability exists. Unless much greater progress towards

standardization between companies can be made in the future, it seems unlikely that this situation will change materially.

It is possible that a central warehouse might offer some savings of personnel, particularly on weekends and holidays. But it is not obvious that these savings would be substantial. The Commission heard many complaints about the difficulty of getting emergency parts service on weekends or holidays. All companies reported that their branches provide dealers with emergency telephone numbers which can be used to order parts when the branch office is closed. Such arrangements may run into a major difficulty at the branch level for some companies and at the main parts warehouse for nearly all companies. Union agreements often contain provisions that greatly increase the cost to the company of providing emergency service. A single request for one part on a weekend can involve a minimum of three people having to be paid straight overtime or double-time rates, with minimum "call-in" hours (generally four) involved. The three people involved would be a stock "picker-packer" to find the part and get it ready to ship, a billing clerk to charge it out and the supervisor to represent the company and see that the job is done. If one takes a minimum-wage cost of $3.75 an hour, the cost of the first two—at time and a half for four hours—is close to $45 for handling a single emergency order. It is perhaps not surprising that some companies provide no service at all from their parts warehouses on weekends.

Union regulations of this kind appear to show on the part of the union an almost callous disregard for the welfare of the farmer-customers who have bought the product its members produce or handle. It may, however, simply reflect a lack of understanding of the emergency nature of the problem that often faces a farmer on a weekend in a busy season. In any case, some improvement in this situation must be effected. I would recommend that farm organizations negotiate directly with the unions and companies involved in order to work out more equitable arrangements for providing emergency service on weekends at more reasonable costs, wherever present union regulations impose unreasonable and excessive costs. Provincial governments might well take the initiative in bringing together the parties involved.

Given the fact that the nature of the repair parts problem makes it pretty well inevitable that a large number of parts will be kept in regional and central branch warehouses, the provision of efficient and rapid service in emergencies requires swift communication of the farmer's needs, prompt action on the part of the company in filling the farmer's order, and transport of the part to the farmer with a minimum of delay. Despite the fact that we all live in an age where the speed and efficiency of communication and transportation have improved, difficulties in supplying repair parts to farmers on an emergency basis have arisen in each of these areas. Let us consider each in turn.

At the technical level, communications have greatly improved. With all parts recorded on computers, some companies now claim that they can search and find a

part anywhere in North America, even when only one or two exist, in a matter of hours. Dealers may often be connected with their branch by telex. The breakdown in communications appears to occur more frequently at the human level. The farmer does not make the dealer realize the order is an emergency one. Or the dealer may fail to follow proper company procedures so that the emergency nature of the order goes unrecognized at the branch level. The Commission's survey suggests that mistakes of this kind are more likely to occur with smaller and less efficient dealers. They should become less frequent as the farm machinery companies continue to upgrade their dealers and reduce their number. Occasionally a part ordered on a routine basis during the off-season may turn into a part needed on an emergency basis because the part is out of stock, and a long delay occurs before it becomes available. All companies should develop some method of dealing with this situation. Farmers also frequently complain of their inability to find out when the required part will arrive. If all companies could provide their dealers with a prompt estimate of how long it would require to fill an out-of-stock emergency order, the farmer involved would be better able to deal with his problem. In some situations he might be able to have a substitute part produced in a local machine shop. Some companies report that they already provide this information promptly. However, there appear to be considerable variations from company to company in this regard. All companies should give the matter close attention.

Most companies now can respond quickly to an emergency order, provided the part is in their branch or central warehouse, or even available anywhere in their system. One exception to this would be the extra cost imposed by the union regulations referred to above which may result in parts being unavailable on weekends. If the part is out of stock and is not under current manufacture, the delay may be much longer. In some instances components or raw materials may be unavailable because some plant is on strike. Massey-Ferguson reported that on the basis of an analysis of their parts orders over a period of several weeks in early 1967, one part ordered out of every 2,000 was not in stock anywhere in their North American branch office and central warehouse parts-storage system and therefore not available without an extended delay. This ratio appears rather high and suggests that a significant improvement in parts availability might be created by simply stocking more parts at the central warehouse. This may be partly a question of setting higher minimum inventory levels for parts that are selling with at least a few sales every year. Another company reported that it had one machine shop that did nothing except manufacture out-of-stock parts, mainly for machines that were no longer being sold.

Even where the part is in stock at the branch or central warehouse a substantial delay may occur before it reaches the farmer. Such a delay can arise from a number of different sources. Farmers at more distant points must often rely on truck or bus or express service to obtain their parts. Truck lines do not usually operate on Sundays and express offices are also closed. Bus companies may be unwilling to take parts of awkward sizes or shapes or to drop them at unattended points. In considerable part, these are the kinds of problems that the recently

established Canadian Farm and Industrial Equipment Institute should investigate. At the present time the various means of transport apparently give no more attention to an emergency parts order, or for that matter to any other kind of rush or urgent order, than they do to a routine one. There would seem to be no reason why some kind of red-tag, premium-cost, emergency service could not be organized to improve the present situation. I recommend it to the Institute for their consideration.

A similar difficulty of unexpected delays has apparently arisen in respect to parts sent by air. One company complained to the Commission that parts sent by air sometimes were delayed for several days at the air terminal, having to give way to other types of cargo. Correspondence with Air Canada revealed that the problem arose because the parts were being sent via air freight, which would be delayed in favour of air express if there was a large volume of express shipments. Since air express pays a higher rate, it is understandable that the airline gives it preference. Farm machinery companies that want parts to go promptly in emergency situations should be prepared to pay the extra cost of air express.

Another source of delay arises when parts cross the Canadian-U.S. border. Although parts for farm machinery come into Canada on a duty-free basis, they still require a customs form and must be cleared through customs. Where customs officials are not on duty on the weekend, this requirement may create substantial delays. One company reported that on the average its parts shipments from Chicago to Edmonton for a period in September and early October required from two to five days (the average was about three). Since an aircraft can fly this distance in a matter of four to five hours it is clear that man-made obstacles are creating very considerable extra delays, delays that are more serious for farmers living in areas a long distance from central parts warehouses. A significant saving in time might occur if there were direct air service available between Chicago and Western Canada. More important would be some method of overcoming the time delay created by the federal government's own customs procedures. To the farmer waiting for a part where the time lost may seriously jeopardize his year's income this delay is simply intolerable. There would appear to be no reason why some arrangements could not be made which would allow emergency parts shipments to go through without the necessity of formal customs clearance.

The Commission understands that the Canadian Farm and Industrial Equipment Institute has recently been able to make arrangements with the Department of National Revenue to allow farm machinery parts shipments under their C-9 form. This allows the manufacturer to post a bond ensuring good faith, and to make a temporary entry for the total shipment rather than a line-by-line entry giving duty rates for each item and a duty calculation on its value. The normal entry form is completed within a few days.

While this has improved parts shipments in some degree, the main problem remains untouched. The real bottleneck is that parts have to go through customs

gateways which may be manned only at certain hours. Why should the farm machinery companies not be allowed to post a bond in Ottawa that would enable them to make emergency shipments directly to their Canadian dealers? Most of the parts enter duty-free in any case. The Department of National Revenue could develop a multi-part tear-off form that would be filled out by the shipping company in the United States or other foreign country involved. With this form attached to the parcel, shipment would be given automatic clearance through customs at any point going into Canada by any method of transport–bus, parcel post, air, rail or truck. At the point where the shipment crossed the border the responsible person would simply tear off all but one copy of this special form. This set of copies would now replace the parcel for customs clearance purposes, while the parcel sped on its way.

The package of forms removed from the parcel would have: one copy for the entering port officer, one copy to be mailed to the company for normal customs clearance procedures, and one copy for the port officer in the company's home port so that this officer could ensure that the company provided formal clearance. If the forms were serially numbered and accounted for, no parcel could be in Canada without a customs clearance ultimately being made for it. With a little ingenuity the federal government could easily remove the present long customs clearance delays in emergency parts shipments. The time saved would mean a great deal to the individual farmers who now find themselves waiting for parts in a critical period of their farming operations.

A further step the companies themselves could take to accelerate emergency parts shipments would be to offer the farmer a premium cost type of service with some part of the additional cost being chargeable to the farmer.

Case Histories of Warranty, Machine Performance and Maintaining and Repairing Farm Machines

The Commission received many complaints from individual farmers with respect to the warranty, maintenance, repair or operation of their machinery. The Commission was able to follow up many of these with the company concerned and the farmer. Quite often the problem was solved in this way, indicating the importance of communication in maintaining good relations between the farmer and the machinery company. Other cases appeared insoluble to the satisfaction of both parties. To illustrate the kinds of problems that arise, a number of individual case histories–with the names of farmers and companies deleted–are given below.

Case 1. Saskatchewan, Wheat Farm: Tractor – This Saskatchewan farmer bought a tractor in 1966. Within three years, the sleeves and pistons in the first two cylinders of the engine wore out three times, and the valves and valve guides once. Even though the warranty was for only 12 months, the company had paid all costs of repair and all work was performed during the off-season. Yet the farmer was not satisfied, feeling that the cause of the problem had not been corrected. The dealer

and the company suggested that the farmer trade in the tractor and pay $2,000 for a larger one, since he had bought more land. The company proposed as an alternative that the farmer could trade the tractor in for a new machine of the same model, paying $1 an hour rental for the 1,400 hours he had put on the tractor.

From the viewpoint of the company it had been more than fair. It had gone beyond the letter of its warranty commitment, and had incurred repair costs for which it had no legal obligation. The farmer, however, felt that he had never had a satisfactory tractor, that the particular unit he had been sold suffered from some basic defect which would continue to require repair, and that the company would not go on repairing it forever. He did not feel he needed a larger machine, and countered the company's offer with the statement that he would not have been expected to trade a three-year-old tractor that worked properly.

The Commission suggested, and the company agreed, that the situation was exceptional. Something had been wrong with the motor and it might or might not have been cured with the last replacement. The company therefore agreed that, if the engine failed again, it would completely replace it with a new engine.

Conclusion: The company and the farmer had not been in direct communication. The company headquarters, at least, was not fully aware of the farmer's position and feelings. What should have happened (the company now agreed) was that a new engine should have been supplied as soon as it was evident that the first rebuilding job was not satisfactory.

Case 2. Quebec, Mixed Farm: Tractor – A farmer who had purchased in 1967 a tractor of European manufacture from a North American full-line company, wrote to the Commission to record his position before the expiration of his one-year warranty, enclosing a report by a certified diesel expert backing up his claims that his tractor was not working properly. He was dissatisfied with the machine for a number of reasons. A front wheel seemed to be out of line (an axle had been changed by the company), the motor discharged white smoke, and the farmer felt that it used too much diesel fuel. He noted that the coolant level was down at the end of each day's work and assumed that coolant was getting into the combustion chambers of the engine to cause the white smoke. The tractor vibrated badly.

The company provided the Commission with a copy of its service file on the tractor, which indicated that the company was fully aware of the problems raised by the farmer and had taken steps to correct them. First of all, the farmer was using No. 2 diesel fuel, instead of No. 1, as recommended in the Owner's Manual. This had clogged the injectors. Injectors had been replaced a number of times and the farmer warned about using the wrong fuel. The coolant level was lower because it had expanded against the pressure cap and the surplus had drained off. When the liquid had cooled off, it contracted and appeared to be too low to someone not accustomed to a pressurized cooling system. The farmer kept adding water which was lost by expansion each day.

The white smoke was caused not by coolant in the combustion chamber but by the use of the wrong fuel. The vibration was considered by the company's representative to be normal, occurring at only one engine speed related to its natural vibration frequency.

All parts that were possibly faulty were replaced under warranty, and the farmer's son stated in writing that he was satisfied that the tractor was in good shape after the last visit of the service representative.

Conclusion: In this case, the customer evidently did not follow instructions and created at least some of his own difficulties. The company gave good, quick service and detailed consideration to each problem. In the end, the farmer was not satisfied and traded in the relatively new tractor for a much older tractor at a considerable financial loss.

Case 3. Ontario, Mixed Farm: Forage Harvester – In September 1967, a farmer purchased a self-propelled forage harvester with attachments on the basis of its being able to cut material to a very short length. The farmer alleged that the machine did not cut to the short length claimed in the advertising for the machine. Because it did not work, he submitted that he had lost close to $10,000. It would not cut the shortest length for which there were sprockets, and the company's field representatives had not succeeded in fixing it. The farmer was also concerned about the way in which the service representatives had treated the machine.

From the company's viewpoint, the Commission was told, the crop was too old and dry to be harvested properly when they were called in to inspect the machine. Even so, they claimed to be able to cut down to 3/16 inch, when the cutting width was eight to nine feet. The company stated it was confident that there would be no difficulty with the 1969 crop.

In the event, however, it turned out that the forage harvester was not used to cut green material in the 1969 season (the farmer claimed to have had enough left over from the previous year). The chopping mechanism had therefore not received further testing.

Conclusion: It would seem possible that the farmer may have been misled by advertising literature that promised more than the machine could do under certain field and crop conditions. Farmers often claim that advertising exaggerates capacity and performance, or relates capacity and performance only to optimum working conditions. On the other hand, the company appears to have attempted to correct the situation identified by the farmer. The fact that the machine was not used to cut green material in 1969, even on a test basis, weakens the farmer's position.

Case 4. Ontario, Mixed Farm: Tractor – The farmer reported that he had had continuous trouble with his tractor: wiring system burnt out, oil seal failure, injector failure, front axle bolts sheared, hydraulic system failure, clutch plate failure (related to low transmission pressure found to be only 175 p.s.i., instead of 205 p.s.i., a situation that had been the cause of a flashing transmission warning

light which the dealer had claimed to be normal), gasket failure, need for overhaul of starter, input shaft ruined, battery failure. The farmer drew attention to the replacement of the input shaft and clutch plate. He felt the company had admitted that these parts had been inadequately designed by replacing them with improved ones at no cost for the parts even after warranty had expired. Why should the farmer have had to pay even the charge for labour?

In the case of a component with a completely new design (the clutch plate for the power shift transmission, for example) should a company be allowed to market the product without full and rigorous testing over an extended operating period? Although the company claimed its testing effective, it failed to pick up the weaknesses of this particular component in this machine. The farmer suggested that testing should be supervised by outside personnel.

The company concerned based its case on the fact that it had gone well beyond its legal position with regard to warranty on parts. It had noted that it reserved the right to change designs as it saw fit; the clutch plate had simply been improved.

Conclusion: In this case, the farmer appeared to have purchased a particular unit of a machine whose design was defective. The particular clutch plate appeared to have been under-designed. The company may not have done all that it could have to retain the customer's confidence in itself and its products, but this is a judgement which each company must make on its own reading of the particular situation.

Case 5. Alberta, Large Wheat Farm Plus Custom Operation: Combines – Two large combines were purchased in March 1966. During the first year, a raker chain and two feeder chains failed and four front feeder-chain drums had to be replaced. All this work was done at the company's expense. In the winter of 1967, the farm was visited twice by service representatives. During the 1967 harvest the farmer replaced at his own expense two feed chains, three drive belts, and one governor belt. One machine was put aside due to failure of one front feeder-chain drum.

The farmer claimed to have lost 160 acres of flax because the company could not supply sufficient parts in time. The farmer refused to pay the first two instalments due at that time (the end of the free season of use) on the grounds of unsatisfactory service. The company claimed that the farmer did not request service assistance often enough to maintain the machines well. The service representative stated that the farmer was running the pick-up attachment almost into the ground and picking up vast amounts of dirt. Nevertheless each machine worked 2,000 acres in two seasons of use. The Commission suggested that companies try and build in mechanisms to detect and prevent abuse of machines. Warranties could thus be extended further. The company replied that all such mechanisms they had tried could be "shorted out" by a farmer who was trying to get as much production as possible.

Conclusion: Generally, the company does not appear to be at fault in this case. The dealer may be at fault for not ordering parts needed by the farmer quickly enough. The farmer may be at fault for not maintaining and operating his machines better.

Case 6. Saskatchewan, Wheat Farm: Combine -- The farmer purchased a combine from the authorized dealer, but did not want the roller-type pick-up which was standard equipment. He reported that the dealer then suggested a short-line brand, drum-type pick-up. According to the farmer, the combination did not work well in the field. After two hours of use, the farmer asked the dealer to exchange the pick-up. The dealer refused to do so on the grounds that it had been ordered especially for the farmer. In the course of a telephone conversation, the company refused to take the combine back. The farmer traded it for another make while the company was still considering the problem.

The Commission then wrote the company concerned and received confirmation of the same points, but with a completely different connotation. The company reported that the dealer purchased and installed the special drum-type pick-up only at the farmer's insistence, but it was not recommended by company engineers.

Conclusion: It is difficult to correlate the different statements. Certainly, the farmer and the dealer saw the incident from diametrically opposed viewpoints, one of which must cancel out the other. No one gained from the situation and no solution was possible.

Case 7. Ontario, Mixed Farm: Pull-Type Combine -- The farmer purchased a used pull-type combine, ordering with it a new, special type pick-up. The pick-up was not delivered in time and the farmer sued the dealer and the company. The suit was lost because the order had not been placed soon enough to allow for delivery, even under the best conditions.

The farmer then advertised for owners of the same model of machine to make known their operational problems, that were then passed on to the Commission. The Commission then analyzed the complaints and noted that although five of the twelve farmers reporting had indicated that they had no problems with their machines, others reported problems pointing to the basic question of machine capacity. The company responded to the Commission's inquiry with the answer that this was a small machine, intended to be available for small farms which otherwise would not have been able to afford their own grain harvesting equipment. To the Commission's question as to what tests had been carried out to identify the capacity and durability of the machine, no answer was forthcoming, despite repeated requests.

Conclusion: It would appear that this model of combine was really of marginal utility to a farmer. It had been apparently built to a price, with sleeve-type bearings, for example, being substituted for the roller bearings in the main shaft of the same model in the self-propelled version. The lack of durability of these bearings was a major complaint of several of the farmers.

Chapter 28

WARRANTIES ON FARM MACHINERY

During the Commission's hearings, numerous farmers and farm organizations lodged complaints about the warranties currently provided on farm machinery. It was argued that a one-year warranty was not long enough for machines such as combines and hay-balers, which might only be used a few weeks each year. Many proposed that, wherever possible, hour meters be attached to machines so that warranties could be based on number of hours used. The longer warranties currently being provided on automobiles were cited as an example of the kind of warranty farmers would like to see applied to the machines they buy. In some areas, complaints were made about delays and difficulties in securing service for machines still under warranty. A few also stressed the need for extending the warranty on machines that were still not performing properly at the time the normal warranty expired. At least one organization proposed that the farm machinery companies should be liable for crop losses suffered by a farmer where a machine broke down under warranty.

The farm machinery companies argued that there was often a misunderstanding about the scope and purpose of the warranty they provide on farm machinery. It is normal practice in the industry to warrant a new machine "to be free from defects in material and workmanship which may cause failure under normal usage and service when used for the purpose intended". If such failure occurs within the warranty period the machine will be repaired at the company's expense. The repaired machine may carry a warranty for a further period. Massey-Ferguson, for example, warrants all repair or replacement parts "for 90 days from the date of replacement or the unexpired 12 months period, whichever is longer". However, some farmers may expect warranty to cover ordinary wear and tear as well. The longer the warranty period, it was argued, the greater the misunderstanding about the scope of the warranty was likely to be. In any case, they argued, most defects of material and workmanship would show up during the first few hours of use. If genuine defects developed after the warranty period had expired, most companies, it was claimed, would repair the machine free of charge.

Warranties for 50,000 miles or five years of the type provided on automobiles would be difficult to implement for farm machinery. Unlike the automobile which

usually travels on a smooth cement highway, the tractor, the self-propelled combine, and other farm machines make use of many different mechanical and hydraulic components, must work under a variety of field conditions, and have to withstand the stresses and strains of rough terrain, and the repeated imposition of extreme loads. While designed and engineered to withstand these loads, if the machine is to operate properly it must have conscientious maintenance. The extended warranties on automobiles, it was noted, usually require the certification of regular maintenance having been performed. Given the dispersed character of the farm machinery in use, it would be administratively more difficult and expensive to provide the same kind of warranty arrangement on farm machines. Regular maintenance service on automobiles is usually performed on a dealer's premises and regular certification involves little additional trouble or expense. A farmer usually provides his own maintenance service on tractors, combines, and other machines and for this reason certification that regular maintenance had been performed would be difficult to provide.

It was also stressed that tractors and other machinery can more easily be overloaded and abused than is true for automobiles, so that companies must be on guard that they are not being asked to pay for machine failures that are not the result of ordinary expected usage.

In many instances, the warranties of the farm machinery companies are warranties from the dealer to his customer. The farm machinery company in turn agrees to reimburse the dealer on some basis or other for the costs involved. While the form of reimbursement varies from one company to another, a common practice is for the farm machinery company to replace the parts provided under warranty at their normal cost to the dealer and to pay the dealer for his repair services at some percentage of his normal labour rate for that job. For major companies this latter payment is often at 75 or 100 per cent of his regular charge for that job. For smaller short-line companies it may be only 50 per cent or less.

Some information on warranty arrangements from the dealers' viewpoint was provided to the Commission in the course of its detailed follow-up of a selected sample of farmers' complaints. Close to 90 per cent of the dealers interviewed reported that they were reimbursed for parts used in warranty work at dealer cost. In effect, if they used a part from stock to make a repair, it would eventually be replaced for them free of charge by the company. The only cost to them would be the administrative cost of ordering and receiving it. If the part came in a normal stocking order, the company would absorb shipping costs as well. This treatment is somewhat less favourable than that in the automobile industry, where the dealer receives the full retail price for parts, less a fleet discount of about 15 per cent.

In fact, many parts required for warranty repairs will have to be ordered from the branch or central parts depot of the company. Under these circumstances, the dealer will still be allowed his invoice cost of the part but in almost 90 per cent of the cases interviewed he would have to absorb the transportation costs himself. This would be true even in an emergency situation where premium transportation may be needed to get the part to the dealer quickly.

The group of dealers interviewed reported that they had to absorb some 37 per cent of what they considered their normal shop costs in handling warranty work. The hourly rate allowed by the company would cover the direct hourly rate of the employees making the repair, but would not cover the overhead cost of the building, the tools, the specialized machines and the consumed supplies required to do the job. Again, this treatment is less favourable to the dealer than that provided in the automobile industry.

Thus it is clear that the implementation of warranty imposes some cost on the dealer. The dealer may have to absorb freight and telephone costs if the required repair parts are not in stock. He also incurs the expense of picking up and returning the implement to the field. If the machine breaks down in a busy season the dealer may feel obliged to provide a substitute machine until the implement in question can be repaired. The farm machinery companies undoubtedly find it desirable to impose some warranty cost on the dealer in order to deter dealers from pressing dubious warranty claims on behalf of their customers. However, if the cost imposed on him is too great, he may not provide the farmer with the warranty service that the company warranty arrangement is intended to provide.

The cost to the dealer of implementing warranty arrangements undoubtedly becomes part of the accepted cost of a dealer's operation. Still, it is important that the way in which warranty is implemented should not be allowed to impede the provision of a reliable repair parts service in time of emergency. For this reason it is recommended that when a machine under warranty breaks down during a busy season, the farm machinery companies should agree to absorb some percentage—say, 75 per cent—of the cost of obtaining any required parts. This might well cover the cost of long distance telephone calls and premium transportation charges.

For the farm machinery company the problem of warranty relates to the question of machine reliability. Machine reliability, in turn, depends on the way that the machine is designed and tested and the quality control maintained during the manufacturing process. To the degree that the machine does not break down because of better design or higher-quality control standards, warranty claims will be less frequent and will cause fewer problcms for the dealer and the machinery company.

The performance reliability of a complex machine made up of numerous component parts is really only as good as the weakest part in terms of design or quality. Thus reliability is a characteristic which is only possible to achieve if, component by component and sub-assembly by sub-assembly, the machine is designed for certain reliability goals. "A properly designed component will fail only at some point in time beyond the life span for which the part is designed. This point in time is conceptually the mean life for the whole population. To assure that the required life for which a component may be designed can be stated with sufficient confidence, . . . only a relatively small scatter of failure data is permissible."[1]

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[1] H. R. Jaeckel and S. R. Swanson, "Predicting Service Life of Automotive Parts Calls for Random Load Test", *The SAE Journal*, November 1969, p. 42.

This definition of component (and therefore machine) reliability simply states that an average reliability for a part of 5,000 hours of use must be achieved by performances of the total population of such parts very close to the average. To achieve this standard only a few can be allowed to fail many hours below the average.

If this level of predictable consistent performance is achieved, the company can offer a warranty at an acceptable cost level. Such performance predictability requires extensive design testing and production quality controls, and the company that does not or is not able to support such a program will not be able to offer a warranty of equal value to the customer. Warranty is too costly to a manufacturer for him to accept it as a substitute for design and manufacturing quality. Ideally, warranty should be accepted as the residual cost for the very few undiscovered flaws in design or manufacturing. The cost of eliminating these flaws would be much greater than the cost of the warranty itself.

In visiting the plants of various farm machinery companies, the Commission was shown numerous testing and quality-control centres where components of various machines were undergoing tests to measure their strength and durability. Some instances where failure had occurred were also brought to its attention. Two instances may be cited.

In one tractor plant the Commission was told of a series of changes in design which had been found necessary in a certain area of a new type of power shift transmission. Later, the Commission received a letter from an Ontario farmer explaining how his tractor had broken down and that the original transmission design had been replaced with the later design in the process of warranty work. He wondered whether the company could have effectively tested the original design if it had failed so soon in service and had to be replaced. The Commission tried to obtain information on the extent of the testing that had been carried out but the Canadian subsidiary of the company could not supply it.

In another tractor plant the Commission was shown a differential gear on which the company had experienced complaints of broken teeth. The gear in question had been purchased from an outside supplier whose quality control had slipped, producing gears that were too brittle. The result was broken teeth on the gears. The company had no reliable information as to how many tractors might be involved with this defect. More than two years later, the Commission received a farmer's report of how his tractor had been out of service for several months waiting for replacement gears because the original had developed broken teeth. The Commission wrote the company and, possibly fortuitously, the farmer received the missing repair parts within a few days. The company agreed that this was one of the instances of improperly hardened teeth of the type the Commission had seen on its visit some 33 months earlier. This illustrates the length of period over which lapses in quality control may affect machine reliability and a company's warranty problems.

No complete data are available on warranty costs. One firm, International Harvester of Canada, reported during the public hearings that its warranty costs amounted to about 1.1 per cent of its net sales, and said these costs had declined significantly since the firm had begun to assemble its machines to a greater extent at the factory. This suggests that in the past, problems giving rise to warranty claims have often been due to improperly assembled machines. In the Commission's financial questionnaire the machinery companies were asked to report expenditures on quality control. Under this heading a variety of expenditures was included such as warranty costs, the cost of defective work, and scrappage. The results of this survey for firms manufacturing in Canada were as follows:

Quality-Control Expenditures as a Percentage of Manufacturing Cost, 1960-66

	All Firms	Major Companies	Smaller Companies
1960	3.1	3.1	–
1961	1.4	1.4	–
1962	1.4	1.4	0.6
1963	1.5	1.5	1.2
1964	1.1	1.1	0.3
1965	1.2	1.3	0.5
1966	1.4	1.5	0.3

In respect to warranty based on number of hours of use, a recommendation made by many farmers or farm organizations, it would be noted that one company, John Deere Limited, already provides an extended warranty of 24 months or 1,500 hours on engines. In modified form, this extended 24-month warranty also applies to certain parts of the power train.

Summing up this discussion, it is clear that warranty can be considered from the viewpoint of the three different interested groups. The farmer is concerned to have the maximum degree of warranty protection for major machines. He is also deeply concerned about the continuing reliability of his machines, and warranty is just one facet of this question. The farm machinery company is concerned with warranty as an expression of quality—of legitimate pride in the products it makes and sells—but must always be on guard to detect cases of warranty abuse either by dealers or farmers. The dealer is very much the man in the middle, caught between his farmer-customer and the farm machinery company he represents.

Given these different interest groups, the Commission has a number of suggestions which could, it believes, improve the situation:

1. Companies should be encouraged to differentiate more clearly in their warranties among different classes of parts and to extend the warranty to a specific number of hours of use on such machines as tractors and combines where an hour meter (which could be sealed against tampering) is generally included. Not all parts of the machine need be covered by the extended warranty. Certain parts deteriorate with time whether they are used or not, and others such as belts may have different

life expectancies depending on whether they are properly adjusted and maintained. Hours-of-use warranties are already appearing in advertisements for some machines imported into North America from Europe, and it may be that competitive pressures alone will be sufficient to bring about this logical extension of warranties.

2. Companies should be asked to make public the terms of their warranty payments to the dealer. In addition, they should make sure that their warranty terms are clearly explained to the farmer-customer. The farmer would then understand more fully the responsibility of the company and the dealer in warranty settlements. Some of the past difficulties with warranty, and the source of farmer complaints about it, have been due to a lack of understanding of what warranty does and what it is intended to cover.

3. Requiring companies to publish data on their warranty experience and warranty costs would probably be unwise because of the difficulty of ensuring data comparability from one company to another. Nevertheless, it is recommended that the evaluation or testing authority, proposed elsewhere in this Report, should be authorized to collect such data on warranty costs and experience as it finds useful in helping evaluate different farm machines.

4. Finally, some carefully controlled approach to the problem of consequential damages should be undertaken. The Commission has been advised that the liability for damages that takes the form of a loss in a farmer's income as a result of the failure of a machine in the warranty period is already pretty clearly established under the Common Law. However, the Commission is not aware of any such case having been successfully prosecuted. Individual farmers are usually reluctant to seek legal redress for their losses, especially against a large corporation. The matter appears to fall outside the clear area of responsibility of the federal government. It is recommended therefore that provincial governments explore this matter on behalf of farmers, perhaps in consultation with the federal government. One solution might be a requirement that any distributor of farm machinery post a bond to cover consequential damages as a result of a machine failure during a warranty period. Payments could be limited to cases where the amount and cause of the loss could be clearly established. It might also be desirable to set a limit on the amount of loss payable with respect to any one machine and to develop a measure of co-insurance by the farmer so that the loss would not be covered until it exceeds a certain limit, to avoid nuisance claims.

Chapter 29

PARTS STANDARDIZATION

The standardization of parts for farm machines was strongly recommended to the Commission by farm groups appearing before it. In particular, the Saskatchewan Farmers' Union stated:

> We believe standardization of many parts, both within and between companies, would result in savings and better service to all concerned . . .
>
> Dealers would save a considerable amount in overhead on stock to say nothing of the mental anguish of maintaining inventory cards and frustration when parts are not available.
>
> One central bearing distributor would be able to provide the needs of the whole province, with sub-distributors in strategic points in the province.[1]

While acknowledging that certain items such as screw threads had been standardized in the past, "at considerable savings to manufacturers, distributors, dealers and farmers" the brief continued:

> No attempt appears to have been made to even standardize parts within each company for its various machines–such simple items as guards, ledger plates and knife sections are seldom interchangeable between different models made by the same company. Shaft sizes, bearings, belts, chains, hydraulic couplings, oil filters, pulleys, wheels, tires, universal joints, electrical equipment are items which could be standard.
>
> Farmers feel a code could be agreed upon that would provide for a minimum size shaft and/or bearing to withstand a certain stress or strain. Minimum requirements for belts and chains, wheels, tires, hydraulic hose, and couplings, the same.
>
> Of equal importance is a method of identifying belts and bearings. Belts could be numbered A, B, C, etc., for certain widths; 1, 2, 3, etc. for length; and A1, A2, etc., for certain minimum strength. Bearings should be numbered by a standard number by all manufacturers. A code could be agreed upon or established by regulation as to size, both inside and out, as width, etc. If machine companies use the manufacturer's number rather than a part number, considerable savings would accrue.
>
> In the first place machine companies themselves would not require the complicated reference and parts books. Nor would they have to place

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[1] Saskatchewan Farmers' Union, *Brief to the Royal Commission on Farm Machinery*, Saskatoon, March 1967, pp. 26 and 27.

> identical bearings into boxes with different part numbers. Warehousing space would be reduced.[2]

The presentation of the Alberta Wheat Pool noted:

> Although some steps have been taken in the acceptance of standards by different manufacturers in such things as power take-off attachments, three-point hitches, etc., many other items could, it is felt, also be standardized. Bearings, belts, chains, cultivator shovels, knife sections, guards, draw pins, to name a few, could be standardized and made to fit most any make or model of machine. Standardized parts are usually available at a lower price for similar quality.[3]

Similarly, the United Farmers of Alberta Co-operative Limited, strongly endorsed more standardization in its brief to the Commission:

> One of the areas where it would appear that substantial savings might be made is in the standardization of parts. For example, the essential design of a cutter bar has not changed for many, many years. It is true that the drive has been improved, the bracings and the quality of the materials are better but we still have knife sections and guards with ledger plates that break or wear out. We have dozens of them varying slightly in shape, size and in the size of the hole that attaches them to the knife standard. Almost every new combine, swather, mower or forage harvester had an engineer back of it who somehow managed to change something so nothing else will now fit. Every dealer has shelves full of these replacement parts—that is all except the one you broke. Certainly you need different knives for cutting different crops but it seems doubtful if you need ten different kinds to cut ripe wheat. To a lesser extent, the same complaint can be made about sprockets, pulleys, belts and other parts. Any improvement in the situation would have to come from the manufacturers. We oppose laws telling anyone how to build a machine. In that way progress is lost. What we think would be worth considering is having the American Society of Agricultural Engineers set up standards where it is practical to do so for farm machine parts. Machines manufactured to these standards would be entitled to put a decal on the machine stating that they met A.S.A.E. standards. This sort of thing has been done with power take-offs and A.S.A.E. specifications for tractor drawbars are used by most, if not all, manufacturers.
>
> Related to this is the matter of standard parts produced by specialized manufacturers. Bearings and belts are examples. Replacements can be secured from establishments dealing in these products. The problem is that the farmer does not know the part number or even the original manufacturer. It would save everyone a good deal of time and trouble if manufacturers placed in the instruction book accompanying the machine, the original manufacturer's name and part number, along with their own.[4]

These quotations underline the seriousness with which farmers view the question of repair parts standardization.

Three levels of standardization can be identified. The first, the standardization of parts within a company, has been going on at an accelerating pace, the

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[2] *Ibid.*, p. 26.

[3] Alberta Wheat Pool, *Brief to the Royal Commission on Farm Machinery*, Calgary, March 1967, p. 6.

[4] United Farmers of Alberta Co-operative Limited, *Brief to the Royal Commission on Farm Machinery*, Calgary, March 1967, pp. 14 and 15.

comments of the Saskatchewan Farmers' Union notwithstanding. All companies emphasized, before the Commission and privately in correspondence, how seriously the addition of one more different part was regarded in their total parts line-up. They fully recognize the cost of introducing additional repair parts into their warehousing system and try to avoid doing so by making each new part functionally replace another, by making parts interchangeable between models and by using modular design approaches by which large areas of different machines are constructed with the same building blocks.

A good example is provided by the new line of Ford tractors that were introduced in 1965.[5] The seven engine types involved required only three different cylinder heads. Only two starter motors are required, one for the gas and the other for diesel models. Two-ring gears match the two starters. Injectors are common on the diesel engines except for a different hole size for the four-cylinder model. And two oil filters cover all seven engines. Even on something as critical as a piston, five types cover seven engines. Complete interchangeability exists among all engines in 20 other areas, ranging from water pump assembly through gears and idlers for the crankshaft, camshaft, hydraulic pump and idler-gear adapter, to head bolts, thermostats and valve-seat inserts. Such standardization is achieved at some increase in manufacturing cost since it requires the use of a much heavier crankshaft, pistons and other components in the smaller tractors, but this is offset by reduced costs in stocking and handling repair parts.

The second type, standardization between companies in the form of inter-machine compatibility, is increasingly common. Power take-off shaft diameters, spline dimensions and speeds are standardized, as are three-point hitches and drawbar dimensions. Major areas of hydraulics are also standardized. This form of standardization which allows the interchangeability of the tractors and implements of different companies is advantageous to both the industry and the farmer.

However, it is a third type of standardization on which the farmers have placed the greatest stress, and in which there has been the least progress. This involves the standardization of components and parts of farm machines manufactured by different companies. The farmer sees two advantages in having parts interchangeable as between different brands. The larger volume of parts manufactured and distributed would foster competition and reduce parts prices. In addition, the interchangeability of parts would reduce the risk that the farmer would be unable to obtain a part when he had a machine breakdown in a busy season. On large volume parts the "will fit" manufacturers are already providing parts that will fit the machines of different companies. But only a small number of the total parts required by different machines are involved.

A study carried out for the Commission in the summer of 1967 investigated the differences that exist from company to company in a selected number of fast

[5] P. A. Martel, "The 1965 Ford Tractor Engine Family", *Society of Automotive Engineers, Paper 984A,* January 1965.

moving parts.[6] Parts were selected from ten different machines widely used on the Prairies the chisel plow, disk harrow, moldboard plow, grain drill, mower, rake, baler, forage harvester, swather, and combine. One model of each machine was selected and parts for 11 different companies were examined. The parts examined included ledger plates, knife sections, wear plates, knife guards, knife clips, V-belts (100 different belts were examined), roller chains, cultivator sweeps and points, concave disks, wheels, rake and pick-up teeth, bearings, and idlers. Where possible, comparison was made with ASAE (American Society of Agricultural Engineers) standards.

In general this study showed that although there was very little interchangeability of parts between companies, the differences in certain dimensions of otherwise identical parts were often small. There were no significant engineering reasons for these differences in measurement and many of them appeared almost random, as though their primary purpose were to prevent interchangeability. For example, the differences in ledger plates, knife sections, and guards appeared to have little to do with machine performance. They were not functional differences. If the dimensions of a part of a different make could have been substituted, the machine would have performed equally well.

The study also collected data on the volume of sales of different parts recorded for the various companies from their Alberta branch houses in 1965 and 1966. Wide variations in sales volume were shown, with some companies having a large volume and others a very small one. In 1966, John Deere sold 32,205 ledger plates (of one type), Allis-Chalmers sold 785, and Ford 73. It is evident that more interchangeability would improve not only parts availability but presumably also the competitive position of the brands with a smaller volume of sales. This latter factor may explain why major companies resist parts standardization. Even where ASAE standards had been established they were often not followed. For example, although nominal cross-section dimensions for V-belts were followed very closely, belt lengths and methods of measuring belt lengths differ widely from those proposed in the ASAE standard. Again, it was found that a large proportion of the cultivator sweeps examined differed in one or more dimensions from the ASAE standard. Similarly, all wheels in the 5-bolt group were found to differ from the ASAE recommendation in at least two dimensions.

Many of these differences may be accidental. They reflect the fact that design engineers working independently for different companies are almost bound to arrive at different results. But why have the companies not made a greater effort to achieve standardization of parts from one company to another? No precise answer can be given to this question. In some degree, once a company has pursued a given design pattern for a number of years there will be reluctance to change, since the company will still have to stock parts for all its earlier models. Then, too, there may be manufacturing constraints. A company may have followed a particular design

[6] R. G. Cessford, *A Field Study on Parts Standardization*, unpublished Commission study, 1967.

pattern because of the machine tools it has available. A change to a new design might require new investment in machine tools and almost certainly would require additional tooling expense. In addition, companies like to keep their customers coming back to their dealers for parts. Not only are parts sales profitable to both the company and its dealers, but a returning customer is also more likely to buy other products sold by the company.

Most of the suggestions for parts standardization by farmers involve relatively fast moving parts. In fact, fast moving parts make up only a small proportion of all the parts carried by the industry. As pointed out in Chapter 27, in North America the Massey-Ferguson company currently stocks some 100,000 different parts. Yet only some 1,500 of these were parts for which a MF dealer would sell, on the average, one or more per year. If standardization is intended to go beyond fast moving wearing parts and reach into the heart of the machine to cover individually designed shafts, gears, and pulleys, it becomes almost impossible to achieve. The matter was expressed very well by a prominent agricultural engineer in correspondence with the Commission:

> . . . when it comes to the question of persuading combine manufacturers, for example, to standardize major parts of the machine then I think you will always run into difficulties. A design of a combine or any other sophisticated machine for that matter, is based on technical knowledge, but requires considerable creativeness on the part of the designer; all men who are creative tend to regard their own efforts as superior to those of others. Furthermore, a design involves a very large number of compromises and it is frequently well nigh impossible to accommodate major parts of another design in one's own concept. I believe, therefore, that in the agricultural engineering industry we should press on with our efforts to get individual components standardized. For major parts of a machine I just do not think that the results likely to be achieved would be worth the trouble and time taken.

Thus, once we recognize that the farmer has an interest in having a choice for his major items of machinery among the competitive designs of different companies, it is clear that we must also recognize that standardization among companies will never be carried beyond certain limits. However, even for fast moving parts, progress has been extremely slow. What can be done about this?

Responsibility for standardization has been largely in the hands of the Farm and Industrial Equipment Institute (FIEI), the Society of Automotive Engineers (SAE), and the American Society of Agricultural Engineers (ASAE), all U.S. organizations. Proposals for standards are usually formulated by an engineering committee of the FIEI and submitted for approval to the SAE for tractors or to the ASAE for other implements. In some instances both associations may be involved. If acceptable to all the associations consulted, the standard will usually be published. No method is provided to enforce or even encourage the standard's adoption by individual manufacturers.

Since 1965 greater progress in processing and adopting proposals for standardization has been achieved, largely as a result of the establishment of the

Co-operative Standards Program (CSP) on the initiative of the ASAE. The CSP has succeeded in getting manufacturers of tractors and farm machinery as well as suppliers of materials and components to contribute funds and, in some cases, the time of engineers for the development of standards. In the two years following the establishment of the CSP, 17 new standardization documents were adopted and 37 documents were revised. Prior to CSP, standardization efforts were financed almost entirely out of the ASAE membership dues paid by individual engineers. Evidence of this increased activity is provided by the number of ASAE standards, recommendations and data officially adopted through the standardization procedures of the American Society of Agricultural Engineers. The official *Agricultural Engineers Yearbook* listed 51 of these in 1960, 80 in 1965, and 99 in 1967.

Other organizations concerned with standardization include the International Standardization Organization (ISO), sponsored by the United Nations Economic and Social Council (ECOSOC), the Organization for Economic Co-operation and Development (OECD) and the European Committee of Associations of Manufacturers of Agricultural Machinery (CEMA). In Canada, an agricultural implements committee of the Canadian Standards Association was active at one stage, but it was discontinued in 1964 because of lack of interest.

An examination of the work of these various organizations makes it clear that progress in the field of standardization depends very largely on the funds available for the support of activities in this field. The various farm machinery companies obviously have very mixed motivations in this field.[7] In so far as standardization among different models of their own machines is concerned, they have a strong interest in achieving results and make very considerable efforts to do so. Massey-Ferguson reported that in its North American operations it employs ten engineers and technicians whose sole responsibility is the development of production and design standards. Similarly, Deere & Company reported that it maintains a standards committee made up of 26 members of its organization, including vice-presidents and material and production engineers. In addition, for standards which involve the compatibility of the tractors and machinery of different companies, very considerable progress has been made. It is in the area of standardization of parts among the various machine models of different companies where both the effort and progress has been minimal.

This analysis of past experience strongly suggests that no progress is likely to be made in this area, in the future, unless there is a larger effort. One way of achieving this would be through a modest expenditure of public funds designed to encourage more research into the possibilities of standardization and to provide some of the leadership required to achieve it. A recommendation along these lines is

[7] A good instance of this mixed motivation is the following. As far back as 1930 the hole spacing in knife sections was raised for discussion in various standards associations. About the same time the matter of power take-off standardization was placed on the agenda for discussion. Agreement on standards for power take-offs was easily reached, for it is clearly to the industry's advantage. Hole spacing is still under discussion. See E. W. Tanquary, "Standardization: World-Wide", *Agricultural Engineering*, September 1963.

made elsewhere as part of a proposal for a government-sponsored and -financed research and testing organization. It is also recommended that the standards committee established by this organization consider the creation of some form of standards approval, such as a decal which could be displayed on machines meeting certain approved standards for interchangeability of parts.

Related to the question of standardization has been the complaint by farmers that components such as belts and bearings, which are provided to most farm machinery companies by common suppliers, can often be identified in the machinery manufacturing company's parts catalogue only under that company's brand name. What farmers would like to see would be a parts list that provided alternative sources for the part in question. For bearings, it was stated that a further advantage was available in that bearing manufacturers had available a cross-classified parts list which provided the parts numbers for identical bearings manufactured by different firms.

The Commission investigated the situation in correspondence with the Anti-Friction Bearing Manufacturers' Association. It found that the common coding system did identify bearings of the same dimensions, but that there was no guarantee that the internal structure of the bearings manufactured by different firms was the same. One bearing might have one more or one less ball or roller in its make-up, and the hardness and finish of the metals might differ between bearing brands. Thus there is no guarantee that one bearing will last as long as another. Being dimensionally identical, the substitute bearing would fit. But the farmer buying it would be taking some risk that it might not perform as well as the original bearing.

Some companies already provided references in their parts list as to where an identical part can be obtained from another firm. The Commission strongly recommends that all firms who manufacture equipment where a cross-classified parts list is likely to be a significant service to farmers should do likewise.

In concluding this section, it is important to recognize that while more progress is possible in the area of standardization, it would be unwise to expect too much. The sheer number of different parts used by the various manufacturers makes it unlikely that much progress can be expected outside a limited number of functional parts which sell in large volume. Manufacturers are constantly attempting to improve their products. These improvements may at times involve changes that require the abandonment of parts on which standardization agreements had been reached. Thus over time old standards will have to be abandoned and new ones established. With a constantly moving target, effort will have to be continuous, and success can never be complete.

Chapter 30

FARM MACHINERY PROBLEMS AT THE DEALER LEVEL

A number of the farm machinery problems drawn to the Commission's attention come into focus most sharply at the dealer level. Dealer organizations expressed concern about a wide range of problems involving their relationship to the manufacturer from which they hold a franchise. Farm organizations expressed concern about the quality of the service personnel employed by dealers. This chapter will discuss a number of these problems. Some attention will also be given to the Farm Machinery Acts that have been passed in a number of provinces.

Dealer complaints were summarized by the Canadian Federation of Farm Equipment Dealers in the following way:

> The wholesaler, usually a wholly owned affiliate of the manufacturer working on a fixed markup, appears to shift most of the risk and uncertainty of doing business to the retail dealer. The dealer contract does not appear adequate. Some of the reasons for this are as follows. [The companies' policies on buying back] repair parts upon closing out [a dealership] discriminates against the dealer . . . . . The wholesaler is interested only in fast moving stock and the balance becomes a complete liability to the retail dealer upon cancellation of his sales contract, as he no longer has a dealership outlet. A franchise cannot be sold by the dealer. Thus it is virtually impossible for [him to receive] compensation for goodwill which he may have built up in the community . . . . Warranty arrangements are less than satisfactory to the dealer. Although warranty parts are supplied without cost to the dealer, he absorbs freight, telephone costs, expenses of picking up and returning the farmer's implement to the field and up to 50 per cent of the shop service costs. Furthermore the dealer has little protection against poorly-designed and -tested equipment in most cases. . . . Upon cancellation of a franchise by the wholesaler, the latter is in no way obligated to assume responsibility for a portion of the lease or building costs which may be still unexpired. . . . The dealer bears the risk and uncertainty of poor crops through the required advance ordering of new machinery almost one crop prior to delivery of new equipment from the wholesaler. The dealer not only bears the burden of extra financing in case of machinery carry-overs due to poor crop conditions, but he also bears a large amount of the depreciation on this unsold new machinery stock. Main-line equipment wholesalers frequently resist organization of the retail dealers and they also resist short-line franchises which the dealer may undertake in order to increase his profits.[1]

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[1]Taken, with some editing, from The Canadian Federation of Farm Equipment Dealers, *Brief to the Royal Commission on Farm Marchinery,* Calgary, October 1967, pp. 35, 38, and 39.

A number of the points raised in the above paragraph have been examined elsewhere in this Report and will not be considered further here.[2] Consideration will be given to the nature of and provision for termination of the franchise agreement and provisions made for the return of wholegoods and repair parts upon termination.

It was noted earlier that the number of franchises granted by ten major farm machinery companies had fallen from around 5,000 at the beginning of the sixties to about 3,000 today. It is evident that within the past few years a large number of dealers have had their franchises terminated and have had to retire or seek employment elsewhere. Some of them may have taken on other short-line franchises. There can be no doubt that this decline in dealer numbers is part of a general rationalization of the pattern of distribution which will reduce costs and provide the farmer with a better service. It parallels the trend towards smaller and fewer farms. Both are symptomatic of the rapid progress that characterizes some sectors of our society. While the progress reduces costs and increases productivity, it may adversely affect many groups in the process. Often these will be the older, the less well-educated and, in general, the less fortunate members of our society.

In the long run all society benefits from progress that raises productivity. But society should also be prepared to alleviate the costs this progress imposes on the less fortunate. Applying this principle to the dealership problem, there is a strong case for requiring a longer period of notice prior to the cancellation of a franchise. Cancellation for legitimate cause would be an exception. Longer notice would give the dealer affected more time to dispose of machines and repair parts he has accumulated, and to make arrangements for some alternative employment. Accordingly, it is recommended that legislation be passed requiring 12 months' notice before any farm machinery franchise is cancelled. This should not impose any significant hardship on the companies. Some companies have told me informally that they usually warn dealers well in advance of an impending cancellation.

The problem of disposing of new machines and repair parts in the hands of the dealer when a franchise is cancelled poses a more complex problem. The Province of Saskatchewan has recently passed legislation requiring that, for new machines, the farm machinery company should take the machine back at its invoice price plus 100 per cent of the costs of return transportation. For repair parts, the supplier must take back any unused parts that are clearly identifiable at 85 per cent of the current net price. Both provisions apply only to parts and machines that are listed in the supplier's current price list.

This provision should not create any difficulty with respect to new machines. For parts, however, much will depend on how the "current" price list is defined. Given the fact that a great many parts have a very low turnover even at the national or continental level, it is not difficult for a dealer over the course of time to acquire

[2] See Chapter 10.

an inventory of parts which he may have little prospect of selling. Some machinery companies advise their dealers to stock a part only if they have sold one or more in the past year, and even then only if it appears on the company's guide list of higher-turnover parts. It would be unfair to require companies to acquire parts for which they already have adequate lifetime stocks, or parts that were ordered against the company's advice. Moreover, many of the companies have policies allowing dealers to return parts ordered by mistake, or parts not suited to their area. A parts-return policy that was too restrictive to the companies would have the effect of increasing the price of parts to farmers, and this should be avoided. Nevertheless, some provision along the lines of the current provision in the Saskatchewan Act would be desirable, if it were limited to faster moving parts and did not include parts the dealer had been warned against stocking. The recommendations made elsewhere with respect to an initial limitation and possible outright ban on interest-free floor-planning of wholegoods will reduce the risk now assumed by the dealer in the form of a heavy inventory of new machines.

It is useful to compare the position of the farm machinery dealer to that of the automotive dealer in relation to their franchising companies. Three companies in the farm machinery field (Ford, International Harvester and White Motor) are also in the automotive field. Dealer representatives have claimed to the Commission that the farm machinery dealer was worse off than the automotive dealer.

As far as it seems practicable to do so, the status of the two dealer groups is set out in tabular form on Table 30.1. While many other aspects of the contracts are substantially identical, the farm machinery dealer generally seems to be at a disadvantage in five of the six areas shown on the table. His security of tenure is less in all but one case than the standard of the automotive companies. Company obligations on termination and in the obligation to assist in the disposal of premises are much less advantageous to him. He is also at a disadvantage in selling wholegoods back to the company and in the return of repair parts. The automotive companies generally reimburse their dealers for warranty work so that it is not less profitable to them than commercial work; in the farm machinery industry, however, the dealer is obliged to support part of the cost of warranty from his own pocket. All automotive companies have dealer councils; three of the farm machinery companies do not. One of these expressed real reluctance to seeing such a form of dealer pressure being developed; another, which already had an automotive dealers' council, said that its experience on the automotive side indicated that really positive results were attainable. The single company that had a dealer council for some time was enthusiastic about it. No farm machinery company had a formal program to assist new dealers with capital until they were established; all automotive companies do this regularly, taking an equity position in the dealer's company which the latter can buy back out of profits. One place where the farm machinery dealer has an advantage is that the farm machinery company provides his wholegoods inventory on an interest-free basis. While each difference noted is in itself small, the cumulative effect of all the differences may be to weaken the farm machinery dealer body in relation to what it could be potentially.

TABLE 30.1–COMPARISON BETWEEN DEALER FRANCHISE AGREEMENTS OF SIX FARM MACHINERY AND THREE AUTOMOTIVE COMPANIES

Typical Farm Machinery Franchise Agreements (six companies reviewed)			Typical Automotive Franchise Agreements (three companies reviewed)		
TENURE	– Termination by dealer	– no provision in agreement (1 company only)[1] – on 30 days notice (3) – at will (1) – on 90 days notice (1)	– on 30 days notice (3 companies)[1]	– Termination by dealer	– TENURE
	– Termination by company	– immediately for cause[2] (1) – immediately for cause[2] or 30 days without cause (2) – immediately for cause[2] or mutually agreed time without cause (1) – immediately for cause[2] or 90 days without cause (1)	– immediately for cause[2] or after 90 days notice for dealer failure to meet company standard. Termination may be deferred for up to one year in the case of death or incapacity of the dealer, provided dealer or his executor or administrator applies for special consideration (3)	– Termination by company	
COMPANY OBLIGATIONS ON TERMINATION	– Wholegoods (complete machines and accessories)	– if termination because of death of dealer, company will buy back dealer interest. If through dealer fault, company has no obligation (1) – dealer will deliver free and clear of all encumbrances to the company branch all new, current, unused and salable complete machines and attachments. . . at net prices charged to dealer, less all discounts, but no more than the current prices; no allowance for transportation costs (2) – company will pay net prices plus transportation costs (1)	– all new and unused motor vehicles of the current model on hand. . . at dealer's net cost, including destination charge paid therein (1) – as above, but limited to those purchased within the 180 days immediately prior to termination (1) – at dealer's net invoice price, current at the effective date of termination, unless cancellation was because dealer took on new line of motor vehicles, other than those manufactured by company (1)	– Wholegoods (complete machines and accessories)	– COMPANY OBLIGATIONS ON TERMINATION

		– if termination without cause, company will repurchase each new, unused and undamaged. . . [machine]. . . listed in the current price and data book at the current model price therefor paid by dealer to company, exclusive of costs of distribution, delivery, handling, advertising, etc. If termination for cause, company has option to repurchase (1) – if termination initiated by company, it will pay net charges plus transportation costs; if by dealer, or company because of dealer fault, company will pay 90% of net prices plus transportation costs (1)			
	– Parts	– on the same basis as wholegoods (2) – in accordance with current return policy (1) – at current dealer net price, less 15% (1) – as listed in current price list (except for slow-moving parts) at current Net Price less 15%. Dealer pays transportation costs (2)	– prices in the current parts price list (2) – purchased from company at prices agreed to; dealer's current buying prices in effect at date of termination plus 5% (2) – purchased within last 12 months at wholesale price less all discounts; company pays transportation costs, if any (1)	– Parts	
	– Tools	– special tools not mentioned (6)	– special tools repurchased at mutually agreed price (3)	– Tools	
	– Premises	– no arrangements (5) – signs will be repurchased (1)	– companies will assist in finding purchaser or lessee, or will lease, or will also arrange sublease (3) – signs will be repurchased at mutually agreed price (3)	– Premises	
FLOOR-PLANNING		– interest-free floor-planning, up to 12 months on tractors, up to 23 months on other products (6)	– no interest-free floor-planning provided (3)		– FLOOR-PLANNING

TABLE 30.1 – COMPARISON BETWEEN DEALER FRANCHISE AGREEMENTS OF SIX FARM MACHINERY AND THREE AUTOMOTIVE COMPANIES–*Concluded*

	Typical Farm Machinery Franchise Agreements (six companies reviewed)	Typical Automotive Franchise Agreements (three companies reviewed)	
WARRANTY POLICY	– machines or parts – company credits dealer account with his net purchase price for parts (but not transportation charges) (1) – provide working capital to cover dealer's warranty and policy expense (1) – dealer receives retail labour rate plus 5% of dealer parts cost to cover handling costs (1) – dealer receives retail labour rate plus 10% and cost of parts plus 15% on all warranty work (1) – repair f.o.b. supplier's factory, or furnish without charge f.o.b. its supplier's factory, same or similar part. (No allowance for transportation or labour costs) (1)	– dealers are reimbursed for warranty labour at retail rates in accordance with allowances shown in standard time service schedule (1) – varies by dealer and market, derived from a formula which includes dealer base cost for part plus established markup and additional amounts as incentive for maximum efficiency in warranty service to consumers (1) – on approved warranty adjustments company pays flat rates for operation performed (as recommended by company) at 100% of labour rates (as agreed upon with company) (1)	– WARRANTY POLICY
DEALER COUNCILS	No Dealer Council. Example of reply: "Should there be support from broad segment of dealers, no reluctance to establish such" (3) – does have conference of dealers (1) – have had one for 6-7 years (1)	– all companies have operating Dealer Councils (3)	- DEALER COUNCILS
ASSISTANCE FOR EXPANSION	– no policies to assist dealers in these circumstances (6)	– various plans to assist dealers in expanding their facilities and adding needed equipment (1) – dealer invests 25% and company 75%, with dealer buying back company interest out of profits (2)	– ASSISTANCE FOR EXPANSION

[1] Numbers in parentheses refer to number of companies whose franchise arrangements contained provision noted.

[2] "Cause" in company terms refers to a number of events. Basic among these are dealer bankruptcy, breach of agreement, action adverse to company, death of dealer if an individual, death of a principal if a partnership, etc.

As farm machinery has become larger and more complex in design—with added power and capacity, new transmissions and hydraulic systems, and many new features for operating ease and comfort—the problems faced by the dealer in providing proper repair and maintenance service for these machines have become much more difficult. Not only does the dealer need a substantial investment in tools and specialized testing and repair equipment, but in addition a high degree of mechanical ability on the part of the dealer's servicemen is required. Yet many of the farm organizations appearing before the Commission expressed a lack of confidence in the calibre of the servicemen employed by the dealers. It was reported that "much of the farm machinery is serviced by men who gain their training as they service or repair the machine on which they work". Or, again, it was stated that "most of the mechanics in farm implement servicing are men who have left the farm and have no other qualifications except some personal experience in this field. Their wages are low and their work is inferior. However, the cost to the farmer is high." Certainly it is true that, although a competent farm machinery mechanic needs higher levels of skill than an automobile mechanic, no province today requires for farm machinery mechanics the type of certification demanded for automobile mechanics. Automobile mechanics must undergo a combined technical training and apprenticeship course.

The need for more highly trained farm machinery mechanics appears obvious. Why are there not more servicemen being trained?

The difficulty may lie in a lack of understanding as to who is and who should be responsible. All the major farm machinery companies have extensive training facilities and provide regular courses for their dealers' employees. They have well-equipped laboratories and classrooms and provide the training at no cost to the dealer. The dealer is required to pay his employee's transportation to the site of the course, his subsistence while on the course, and presumably his regular salary during the training. However, a careful examination of these courses clearly indicates that they are not intended to provide basic training for dealer mechanics and employees. Instead, they are designed as refresher or improvement courses for employees who have already acquired basic skills. As such, they serve a very useful purpose. They keep dealer mechanics up to date on the latest developments in the farm machinery companies' equipment, and undoubtedly also help dealer mechanics to maintain their basic knowledge. But the courses rarely last more than a week or two, and cannot possibly provide the basic training that a good dealer mechanic requires.

Recently, three provinces—Ontario, Manitoba, and Saskatchewan—have established special courses to train farm machinery mechanics. The courses have been well designed and appear to provide good training. Yet at the time the Commission was in touch with those responsible (1967), the course at Guelph appeared in danger of being discontinued because of lack of interest. This experience suggests another lack of understanding of the training problem. It was apparently anticipated that the course at Guelph would be attended by employees sponsored by farm machinery dealers. The failure of more dealers to take advantage

of the course is understandable. Even where a dealer sponsors one of his employees as a trainee, he has no assurance that the employee will subsequently return and work for the dealer for any length of time. The newly trained employee may be lured away by a better-paying job in the construction equipment field or elsewhere. Further, with the farm machinery companies all engaged in a program of reducing the number of franchises they offer, many dealers may feel too insecure to sponsor an employee on the course.

Thus it seems clear that someone else should take the responsibility for ensuring that farm machinery dealers are able to obtain a good supply of well-trained mechanics. Not only would the availability of such a supply benefit the dealers themselves, it would also provide a very broad-range benefit to the farm community as a whole. The benefit would take the form of better and faster repairs on farm machinery and less risk of subsequent breakdown. To the farmer, there would be the saving of the crop losses he now suffers because of unnecessary breakdowns from improperly repaired machines or through delays in getting his machinery repaired. These economic losses are quite apart from the worry a farmer undergoes when these breakdowns occur.

For these reasons, it is recommended that the Department of Agriculture in each province carefully examine how the supply of trained farm machinery mechanics can best be increased. The Department of Manpower and Immigration now sponsors many training programs. It may be that a plan for better training can be worked out in co-operation with one of the federal programs now in existence. Perhaps an apprenticeship program with a provision for certification is what is required. Clearly a moderate subsidy to ensure that the improved supply takes place would be fully justified on the basis of the benefit it would provide in terms of a saving in crop loss to agriculture as a whole.

Farm Machinery Acts

Four Canadian provinces—Alberta, Manitoba, Prince Edward Island, and Saskatchewan—now have Farm Machinery Acts designed to regulate or temper the relationship between the three parties involved in the purchase and use of farm machinery, the company, the dealer, and the farmer. A primary purpose of these Acts appears to be that of protecting the interests of the farmer in his relationships with suppliers of farm machinery. Typically, this protection takes three forms. The farmer is allowed to reject the machine he has purchased, after having had an opportunity to test it in his own working environment, if he feels that it has failed to perform satisfactorily the job for which he purchased it, and if the company is unable to make it work to his satisfaction. Dealerships may be licensed so that minimum performance standards can be established and maintained. And an attempt is made to guarantee the availability of repair parts for the machines the farmer buys. In the case of Saskatchewan and more recently Alberta, the Acts provide for inspectors who have the dual responsibility of checking on dealer performance and using their good offices to find solutions for conflicts that develop between farmers and their suppliers.

How have the farm machinery acts worked in practice? Although it is not easy to assess the situation accurately, it is my impression that they have improved relationships between the three parties involved. Undoubtedly, the requirement that a standard sales contract be used (Manitoba and Saskatchewan) or that the sales contract in whatever form contain certain standard provisions (Alberta and P.E.I.) gives the farmer a guarantee that the form of the contract is not weighted in some way in favour of the other party. The rejection clause gives the farmer some protection against high pressure salesmanship and, even for the companies, probably helps ensure that they have satisfied customers.

In principle, the licensing of farm machinery dealerships gives the government an opportunity to ensure minimum standards, and protects the farmers in their direct contact with the company. In fact, provincial governments do not appear to have used this power to upgrade the quality of dealerships.

The problem of ensuring the availability of parts presents a more difficult problem. The earlier Acts required that parts should be maintained within the province for a period of ten years after the date the machine was purchased, and that the purchaser should be able to obtain them within a reasonable time. This requirement has been dropped from more recent legislation but there remains a requirement that the company selling the implement warrant that a sufficient supply of repair parts be made available for a period of ten years from the date of the machine's purchase and that they be available within a reasonable time. It is clear that this change is desirable. Prompt and effective repair parts supply may be provided most economically by one central warehouse serving several provinces. To require that all parts for every machine sold be kept in every province would add greatly to the total cost of repair parts. All of the major companies recognize that they have a vital interest in organizing and maintaining an efficient repair parts service.

A more difficult problem arises in respect to smaller short-line companies. Some of these may begin selling in some part of Canada and organize dealer facilities. Later they may decide that the business in the area is not sufficiently profitable, and discontinue their dealerships. The farmer may be left without any simple or effective way of obtaining parts for his machine. While there is no easy way to solve this problem, one approach would be for the provinces to license distributors of farm machinery. In instances where there was doubt about the future continuance of the company, a requirement could be made that the company post a bond ensuring that a repair parts supply would be maintained for a minimum length of time.

Although many provinces do not have a farm machinery act at the present time, such legislation appears to fulfil a useful purpose and I would recommend to all provinces that they review the legislation now in effect in the four provinces and consider whether it would not be in the interest of their own farmers and dealers to introduce such legislation. For convenience in carrying out this review, the *Farm Machinery Act* for the Province of Alberta, which was completely revised in 1967, is appended to this chapter.

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PROVINCE OF ALBERTA

1967

CHAPTER 20

An Act respecting the Sale of Farm Implements

(Assented to April 11, 1967)

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Alberta, enacts as follows:

Short title

1. This Act may be cited as *The Farm Implement Act.*

Interpretation

2. In this Act,

(*a*) "dealer" means a person operating in the ordinary course of business a retail establishment for the sale or resale of farm implements, repair parts and implement services and who is required to be licensed as a farm implement dealer under *The Licensing of Trades and Businesses Act;*

(*b*) "farm implement" means any implement or machine having the retail sale price of $200 or more and used or intended for use in farming operations, but does not include a motor vehicle as defined in *The Highway Traffic Act;*

(*c*) "inspector" means an inspector appointed under this Act;

(*d*) "purchaser" means a farmer who purchases a farm implement for his own use;

(*e*) "vendor" means a manufacturer or supplier of farm implements who sells, consigns or delivers farm implements to a dealer for sale or resale in the ordinary course of business or who sells or leases farm implements.

Exemption from Act

3. (1) This Act does not apply to sales of farm implements

(*a*) by farmers

(i) by auction sale, or

(ii) in the ordinary course of their farming operations,

or

(*b*) by executors or administrators, or

(*c*) by public officials acting under judicial process, or

(*d*) to vendors or dealers.

(2) *The Direct Sales Cancellation Act* does not apply to sales of farm implements made by vendors or dealers in accordance with this Act.

Form of agreement

4. (1) Every sale agreement of a farm implement, whether new or used,

(*a*) shall be in writing,

(*b*) shall state the address of the principal office of the vendor in Alberta,

(*c*) shall set out the nature and duration of all warranties given in connection with the farm implement.

(2) Notwithstanding clause (*c*) of subsection (1), any warranty may be stated elsewhere than in the sale agreement if the statement

(*a*) is in writing and identifies the implement to which the warranty applies, and

(*b*) is delivered to the purchaser at the time of the sale.

Implied warranty

5. Notwithstanding anything contained in an agreement, every new farm implement sold shall be deemed to be warranted to be

(*a*) made of good material,

(*b*) properly constructed, both as to design and workmanship,

(*c*) in good working order,

(*d*) capable of performing in a satisfactory manner the work for which it is intended, subject to reasonable operating conditions and proper use and maintenance, and

(*e*) designed and constructed in every way so as with proper care and use, to ensure reasonable durability.

Notice of failure on performance

6. (1) Where a new farm implement used under reasonable operating conditions and with proper use and maintenance fails to perform the work for which it is intended in a satisfactory manner, the purchaser may within seven days from the date the implement is first used give notice, by registered mail, to the vendor of the failure to perform and the dealer or vendor shall endeavour to make the implement perform in a satisfactory manner

(*a*) not later than the seventh day after receiving the notice, given reasonable operating conditions, or

(*b*) if reasonable operating conditons do not exist following the receipt of the notice, then not later than the seventh day of reasonable operating conditions after receipt of the notice,

and if the dealer or vendor fails to make the implement perform in a satisfactory manner by the end of those seven days the dealer or vendor shall, within 24 hours provide

the purchaser with a satisfactory substitute implement for the purchaser's use until his implement is made to perform in a satisfactory manner.

(2) If, within a reasonable time after providing the substitute implement to the purchaser, the dealer or vendor fails to make the purchaser's implement perform in a satisfactory manner, the dealer or vendor shall replace the purchaser's implement with an implement which is acceptable to the purchaser or terminate the sale agreement and refund to the purchaser all moneys paid by him in connection therewith.

(3) A purchaser is not obliged to follow the procedure set out in subsection (1) and the fact that he does not follow it in no way reduces the liability of the dealer or vendor for a breach of warranty.

Repair parts

7. (1) Notwithstanding anything contained in the agreement, every sale agreement of a new farm implement shall be deemed to contain a warranty that a sufficient supply of repair parts for the implement will be made available by the vendor for a period of 10 years from the date of the agreement.

(2) Repair parts shall be made available to the purchaser within a reasonable length of time after a request therefor is made to the vendor but the vendor is not responsible for any delay in delivering a required part that is due to circumstances beyond his control.

Time limit on warranties

8. Where a sale agreement of a new farm implement sets a time limit on the duration of any warranty given therein, that time shall be deemed to run from the date the implement is first used within the first normal season of use by the purchaser for its intended purpose and not from any earlier date, notwithstanding anything contained in the sale agreement.

Waiver prohibited

9. (1) Any statement in a sale agreement, order, security instrument or statement of warranties made, taken or given in connection with the sale of a farm implement to the effect that the liability of the vendor as provided in this Act is limited or modified in any way is void.

(2) Subsection (1) does not apply to any statement in so far as it

(*a*) limits the duration of any warranty, or

(*b*) limits the liability of the vendor or dealer for consequential damages arising out of a breach of warranty,

if the limitation is clearly set out in the document setting out the warranty.

(3) Subsection (1) does not affect the validity of the remaining provisions of the agreement, order, instrument or statement.

Effective date of sale agreement

10. A person who signs an agreement to purchase a farm implement is not bound by the agreement until

(*a*) the agreement is signed by the vendor or his dealer or by a representative authorized to bind the vendor or dealer, or

(*b*) he has taken delivery of the machine under the agreement,

whichever first occurs.

Copies of agreements

11. A vendor or his dealer shall

(*a*) keep a copy of every sale agreement of a farm implement entered into by him for at least two years, and

(*b*) upon the request of an inspector, produce the copy and allow the inspector to make copies thereof.

Inspection of vendors' repair parts

12. An inspector may inspect the stock of repair parts maintained in Alberta by vendors and their dealers and for that purpose every vendor and every dealer shall give an inspector admission and free access to his premises during usual business hours.

Return of defective part

13. Any defective part of a farm implement for which the purchaser claims a replacement under a warranty shall be returned within 30 days after the failure

(*a*) to the dealer at the address stated in the sale agreement, or

(*b*) if no address is stated therein, to the vendor or nearest dealer of the vendor,

and if a defective part is returned to the vendor or to a dealer, who was not the dealer who sold the implement to the purchaser, the part shall be accompanied by a written statement containing sufficient particulars of the sale transaction to enable the vendor or dealer to reasonably identify the transaction.

Breach of warranty

14. (1) The vendor of a farm implement and the dealer who sold it to the purchaser are liable to the purchaser for a breach of any of the warranties mentioned in sections 5 and 7 and the purchaser may maintain an action against any one or both of them for the breach.

(2) In any action commenced by a purchaser pursuant to this section, the party against whom the action is brought may as a matter of right add as third parties all persons involved, including the dealer or the vendor and any party to whom any note given in connection with the sale of the

farm implement, or the moneys payable thereunder, has been assigned or delivered, to the end that the rights of all parties may be determined, including any or all counter-claims of the parties against the purchaser.

Arbitration of dispute

15. (1) Any dispute between a purchaser and a vendor or dealer, or both, with respect to any obligation imposed on the vendor or dealer by this Act may, at the option of either party, be submitted to two arbitrators for arbitration under *The Arbitration Act* instead of being settled by action.

(2) Without restricting any other remedies available to a purchaser, an inspector may, on the request of a purchaser, inquire into and attempt to resolve any dispute between the purchaser and a vendor or dealer, or both, with respect to any obligation imposed upon the vendor or dealer by this Act.

Information to Minister of Agriculture

16. Upon the request of the Minister of Agriculture, any vendor selling or offering for sale farm implements in Alberta shall provide the Minister with

(*a*) lists of all types of farm implements offered for sale,

(*b*) lists by category or group of parts maintained in stock by them in Alberta,

(*c*) a statement or true copy of the current published suggested retail prices for those implements and parts, and

(*d*) copies of specific sale agreements of farm implements.

Administration of Act

17. (1) The Minister of Agriculture is charged with the administration of this Act.

(2) Subject to *The Public Service Act, 1962* there may be appointed such inspectors and other employees as are required for the administration of this Act.

Offence and penalty

18. A person who contravenes this Act is guilty of an offence and liable on summary conviction to a fine of not more than $100.

Regulations

19. The Lieutenant Governor in Council may make regulations to give effect to the purposes of this Act,

(*a*) governing the form of sale agreements of farm implements,

(*b*) governing the contents of sale agreements of farm implements, and

(*c*) respecting any other matter necessary for carrying out this Act according to its intent.

Repeal

20. *The Farm Machinery Act*, being chapter 110 of the Revised Statutes is repealed.

Coming into force

21. This Act comes into force on the first day of November, 1967.

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Chapter 31

POSTWAR CHANGES IN PRICES AND COSTS

This chapter examines the postwar increase in the price of farm machinery and parts. It assesses this against the background of changes in wage costs, prices of raw materials, and productivity experienced by the industry. Comparisons are made with the experience of other industries and with data from other countries.

Accurate measurement of the change in the price of a modern farm machine over any extended period of time is extremely difficult. Farm machines have steadily become more complex and sophisticated. The average size of tractor sold in Canada has increased from around 19 HP at the end of the war to about 63 HP today. On the Prairies the corresponding increase has been from less than 20 HP to over 83 HP. In addition, the tractor, which in 1945 was often little more than an engine, four wheels, a transmission, and a simple hitch, has had hydraulics added, now normally includes the three-point hitch and may have more complex weight-transfer devices. It has changed from predominantly gasoline-powered to diesel engine models, and often has power steering, an automatic transmission, and other improvements. Similar but less extreme changes have occurred for many other farm machines. Yet the price index which measures the change in price over time must somehow comprehend and incorporate these differences. In the main, the method used in conventional price indexes is to measure price changes for essentially identical machines a few years at a time, linking these changes together over longer periods. When a new machine appears, incorporating a new feature such as hydraulics, the new feature will often be optional in the first few years. Thus, a price for the machine without the new feature can be obtained for comparison with an identical machine in the previous year. After a few years, the new option may become standard equipment. Comparison then can be made for a machine incorporating the new feature in adjacent years. Thus, a continuous measure of price change over time in what is essentially an identical machine can be maintained. If a major model change occurs, price comparison becomes more difficult. Here the company may be asked to estimate the price at which the new model would have sold if it had been available in the previous year. Or the price increase may be estimated on the basis of the change for companies that did not make a model change in that year. Thus, in principle, an attempt is being made to

measure what is in some sense the pure price increase—that is, the price change that does not incorporate any change in quality. The result is at best a rather rough approximation.

It is also clear that the official price indexes do not attempt to measure many changes that may add significantly to the value of a machine to a farmer. Improvements in metallurgy, better lubrication methods, or improvement in air filters, may increase the durability and effective life of a tractor. The Dominion Bureau of Statistics does not have staff available to evaluate such changes, and in fact does not attempt to measure quality changes of this kind. The addition of sealed bearings to a combine may reduce the time the farmer must spend lubricating his machine, and thus extend the effective length of his working day during the harvest season, so that the capacity of his combine is increased. Self-propelled machines may reduce the grain lost in opening up fields. Many other examples could be given. The Commission had hoped to measure the effects of these improvements for a number of basic machines. Unfortunately, the research it initiated in this area did not yield results that could be published. Thus, while there can be little doubt that important improvements have been made in almost all the machinery used by farmers, it is not possible for the Commission to provide a quantitative measure of how large these improvements have been.

In brief, official price indexes set out to measure a complement of machinery of constant quality. Because machines are constantly changing it is difficult in practice to isolate with accuracy the pure price change. Both improvements and deterioration in quality may go unmeasured. Overall, it is the Commission's view that there has been a substantial but not easily quantifiable improvement in quality.

In theory, it would be possible to measure the change in prices of farm machinery in an even more fundamental sense. An attempt could be made to measure the cost of performing certain farm operations on the assumption that non-machinery technology—such as the varieties of seed, use of fertilizer, and farming methods—had been kept fixed. Such a measure would include the effects of the change from a binder-thresher method of grain harvesting to combining, the substitution of the tractor for the horse, the change from small unsophisticated tractors to the large complex machines in use today, the substitution of the forage harvester for the mower and dump rake, and many other changes. A very substantial part of the contribution made by advances in farm machine technology has taken the form of the substitution of new machines for old. A price index that measures the change in the prices of a given number of machines of constant quality leaves this type of improvement entirely to one side.

While no attempt has been made to measure the effects on farm cost of this type of change, a rough indication of its importance is provided by Table 31.1, showing the change in man-hour requirements for a number of crop and livestock products in the United States over the period since 1910-14. The data are shown in terms of man-hours required per acre or per unit of livestock in terms of numbers. While not all of this reduction in man-hour requirements is due to improved

TABLE 31.1–MAN-HOURS REQUIRED PER ACRE OR PER UNIT OF LIVESTOCK, SELECTED CROPS AND LIVESTOCK, UNITED STATES, SELECTED PERIODS, 1910-14 TO 1963-67

	1910-14	1925-29	1935-39	1945-49	1955-59	1963-67
Man-hours per acre						
Wheat	15.2	10.5	8.8	5.7	3.8	2.9
Corn for grain	35.2	30.3	28.1	19.2	9.9	6.1
Hay	11.9	12.0	11.3	8.4	6.0	5.5
Potatoes	76.0	73.1	69.7	68.5	53.1	45.9
Sugar beets	128.0	109.0	98.0	85.0	51.0	35.0
Soybeans	–	15.9	11.8	8.0	5.2	4.8
Milk cows:						
Man-hours per cow	146	145	148	129	109	84
Chickens: laying flocks						
Man-hours per 100 layers	–	218	221	240	175	107
Chickens: broilers						
Man-hours per 100 birds	–	32	30	29	23	14

Source: U.S. Department of Agriculture, *Agricultural Statistics,* 1968, Tables 665 and 666.

machinery, advances in machinery technology are undoubtedly the source of a major part of it.

The reduction in man-hours required for grains is particularly striking. By 1963-67, wheat was being produced in the United States with an expenditure of less than 3 man-hours per acre compared with over 15 in 1910-14. In the production of corn for grain, the decline has been even more dramatic, from 35 man-hours per acre in 1910-14 to 6.1 in 1963-67. Significant but smaller declines are shown for soybeans, hay, potatoes, and sugar beets. For livestock products, the declines are generally smaller but still substantial. For broilers and laying flocks, the man-hour requirements have fallen to about one-half their level in 1925-29 and for milk cows the decline has been around 40 per cent. It can be assumed that similar changes have occurred in Canada, for the farm machinery in use in the two countries has been broadly comparable.

Official Price Indexes of Farm Machinery

Prices of farm machinery may be measured at a number of different transaction levels. One of the most widely used for index purposes is the *suggested retail list price,* the price which usually appears in the price lists issued by the companies. List prices are used in the farm machinery component of Dominion Bureau of Statistics *Price Index Numbers of Commodities and Services Used by Farmers.* The list price is normally the starting point for bargaining between the farmer and the dealer. In fact, the farmer usually buys at a discount below this price. No direct information is available on the change over time in the prices actually paid by farmers. In fact, the price paid by farmers is extremely difficult to measure because many sales involve trade-ins and the value of any given trade-in is a

matter of judgement. Some approximation of the extent to which dealers actually sell below the list price can be obtained from dealer operating statements which provide information on the margin obtained on their sales of new and used equipment. Such an estimate is given below.

Another price level is the *net wholesale* or *dealer price.* This is the price the company charges the dealer after various allowances. The price to the dealer is normally quoted in the form of a discount from the list price. In addition, the dealer usually receives an allowance based on the volume of his sales. He may also

TABLE 31.2–DEALER TRADE DISCOUNTS ON FARM MACHINERY (BEFORE VOLUME BONUSES), MAJOR COMPANIES, CANADA, 1948-68

		Percentage Discount	
Allis-Chalmers	1955-60	20 (25 on engines and power units)	
	1960-68	20, 23, 26 (depending on kind of machine-use, 23 for combines and tractors)	
J. I. Case	1948-58	18.8 (average)	
	1959-68	23 (average)	
John Deere	1948-55	16	
	1956-63	20	
	1964-68	23	
Ford	1948-53	20	
	1954-55	25	
	1956-59	20	
	1960-68	20	
International Harvester	1948-59	20	
	1960-68	22	
Massey-Ferguson	1950-51	15	
	1952	16	
	1953-57	17.5	
	1958-68	23	
		West	East
Oliver, Cockshutt	1962	23	23
	1963	20	23
	1964	20	23
	1965	20	23
	1966	20	23
		Presently 23% in both East and West.	

Source: Royal Commission on Farm Machinery, Questionnaire #2, re: Distribution Policies and Operations.

receive an added discount for prompt payment. At the present time the price to the dealer averages about 27 per cent below list price, made up of a trade discount of 23 per cent and a volume bonus of around 4 per cent. However, the exact discount allowed varies from company to company and has changed over time. Some information on current discounts and their changes over the postwar period for a number of major companies is given in Table 31.2. There are no price indexes for Canada which show the change in the net dealer price over time. However, the U.S. wholesale price index of farm machinery is essentially a net dealer price index.

Still another level at which price can be measured is the *net selling price at the factory*. Many companies ship farm machinery from the factory to the companies' own branch warehouses or in some instances directly to the dealer. Since this involves a transfer of the machine from one division of the company to another, it is not an arm's length transaction, and thus is not in any sense a market price. Where the machine crosses the Canadian border either as an export or import, the price established will affect the division of company profit between Canada and the other country, and thus the price will be of potential interest to the Department of National Revenue. However, as has been shown elsewhere in this Report, the basis on which transfer prices are set seems to vary substantially from company to company and appears to be fairly arbitrary. The farm machinery component of the Canadian publication *Industry Selling Price Indexes* is apparently a transfer-price index.

In brief, published price indexes in Canada and the United States record either suggested retail list prices, net wholesale prices—that is, the price to the dealer—or industry transfer prices. None of these record the price the farmer actually pays. A Canada-U.S. comparison of price changes since the end of the Second World War shows the following results:

	Canada		United States		
	List Price to Farmer	Industry Selling Price Index	List Price to Farmer	Net Wholesale Price	
	(1945=100)	(1956=100)	(1945=100)	(1945=100)	(1956=100)
1945	100		100	100	
1949	138		153	149	
1952	170		175	167	
1956	181	100	185	175	100
1967	262	123	262	233	133

Although not fully comparable, the two official indexes of the list price to the farmer show about the same increase in both Canada and the United States over the postwar period. The index for 1967 in both countries (on a base of 1945

equalling 100) is at the same level, 262. In both 1945 and 1967, the Canadian dollar was at a substantial discount to the U.S. dollar, the official exchange rate being $1 U.S. equal to $1.10 Canadian in 1945 and $1.08 Canadian in 1967. The U.S. index, a component of the index of prices paid by farmers, is based on a survey of dealers who are asked to quote prices on farm machines typically bought by farmers in that area. Because the machines are not precisely specified from year to year, it is believed that the index may overstate the price rise from machines of constant specifications. Over time, farmers have begun to buy machines with more options and special features. The prices are generally believed to be suggested list prices, but even this is not known for sure. The Canadian index of the price of farm machinery to the farmer is a component of the DBS *Price Index Numbers of Commodities and Services Used by Farmers.* Until very recently it has been explicitly an index of the list price of a fixed complement of machinery of constant specifications. When machines change, an attempt is made to identify the change in quality arising from the addition of new options or special features. However, the index is based on prices supplied directly by the farm machinery companies, and data are collected from only two companies.

Evidence available from surveys of dealer operating margins shows that, on the average, farm machinery now sells at about 15 per cent below list price, whereas immediately after the war it sold at list price or at some premium over list price. If the official index for the price to the farmer in Canada is adjusted for this difference in dealer operating results, the following results are obtained:

	Dealer Margin on New and Used Equipment as Percentage of New Only	Farm Price as Percentage of List[1]	List Price to Farmer	Price to Farmer Adjusted for Dealer Discounts
1945	21.8[2]	102	100	100
1949	19.9	100	138	135
1952	17.4	97	170	162
1956	16.0	95	181	169
1967	10.8	85	262	218

[1] Estimated on the assumption that the dealer trade discount was about 20 per cent from 1945 to 1956 and 23 per cent in 1967.

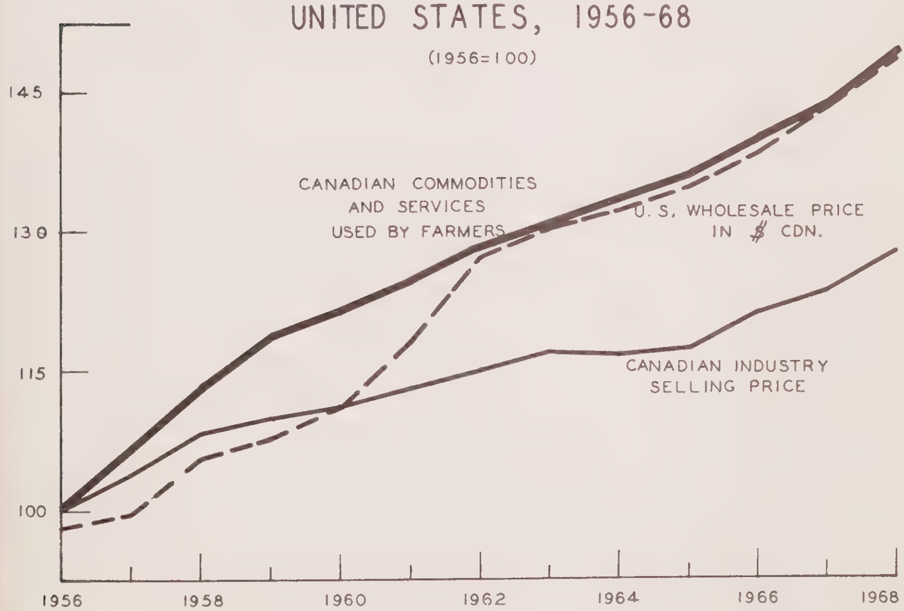
[2] Data are for 1947. Data for all years are taken from *Cost of Doing Business Study*, National Farm & Power Equipment Dealers Association (St. Louis, Mo.), annual publication.

As the data in the last two columns show, after allowance for the smaller margin taken by the dealer, the increase in the official index of farm machinery prices in Canada over the period from 1945-67 is reduced from 162 per cent to 118 per cent. An increase of 118 per cent is much more in line with the increase over the same period of 133 per cent shown by the U.S. wholesale price index. This latter index is an index of the conventional type, which attempts to measure the change in price of a complement of machinery of constant specifications. New

machines are added to the complement from time to time and old ones are dropped, but this change in components is not allowed to influence the measure of price change. No equivalent wholesale price index is available for Canada.

For the period since 1956, DBS has published an industry selling price index for farm machinery which measures the net price of machinery at the factory. A comparison of this index with the U.S. wholesale price index of farm machinery and equipment, converted to Canadian dollars at official exchange rates, reveals a substantial disparity in the behaviour of the two indexes (see Figure 31.1). Further, this difference cannot be attributed to a difference in the composition of the two indexes. The Canadian index includes only machinery manufactured in Canada and, for this reason, excludes tractors. Tractors have a weight equal to about 35 per cent of the U.S. *Wholesale Prices and Price Indexes* of agricultural machinery and equipment. However, the price rise shown by tractors and other agricultural machinery has been very similar. The price rise from 1956-67 for tractors was 35.9 per cent, and for other agricultural machinery 36.2 per cent. The difference between the two indexes must be due mainly to the fact that one is an index of somewhat arbitrary transfer prices which have no market implications, whereas the other represents prices at which machines are sold in the market to dealers. It will be noted in Figure 31.1 that following the devaluation of the Canadian dollar in 1961 and 1962, the U.S. wholesale price index in Canadian dollars paralleled very closely the Canadian index of the price to the farmer.

FIGURE 31.1-COMPARISON OF FARM MACHINERY PRICE INDEXES, CANADA AND THE UNITED STATES, 1956-68



The divergence between these two indexes over the period since 1956 is quite substantial, as the following comparison shows:

	Canadian Dollars	U.S. Dollars
	(1956 = 100)	
U.S. wholesale price index	146.2	133.0
Canadian industry selling price index	123.5	112.8

Thus, whether the comparison is made in Canadian or U.S. dollars, the increase in the U.S. wholesale price index of agricultural machinery and equipment has been two or more times as large as the increase shown by the Canada industry selling price index of agricultural machinery. Since a large part of Canadian production is exported, much of this difference must simply reflect the basis on which the Canadian companies choose to determine transfer prices to their U.S. associated companies.

The Postwar Rise in Tractor and Combine Prices

The U.S. *Wholesale Prices and Price Indexes* of farm and garden tractors increased by about one-third from 1947-56, and by a further 42 per cent from 1956-68. Converted to Canadian dollars at official rates of exchange, this implies a rise of about 30 per cent in Canada from 1947-56 and a further increase of 53 per cent since 1956. The indexes are as follows:

U.S. Wholesale Price Index of Farm and Garden Tractors

	Canadian Dollars	U.S. Dollars
1947	77	76
1956	100	100
1968	153	142

In order to provide more detailed information on the recent rise in tractor prices, the Commission estimated changes in tractor prices by major horsepower groups for substantially identical tractors over the period from 1956-68. Since many of the tractor models included in the index changed moderately in horsepower size over the period of the index, prices are shown in terms of price per power take-off horsepower. Where options included in later years were not available in earlier years, the cost of the option in the first year was used for these earlier years. The results for each of the seven size classes of tractors are shown in Table 31.3. An index of all groups, giving each horsepower class equal weight, shows a price increase of just over 34 per cent from 1961-68.

For combines, no convenient standard specification or division among size classes was available. Accordingly, a representative group of eight different combine models sold in 1969 was identified and traced back through company specifications and price data year by year until the introduction of the model in question. At that

TABLE 31.3–TRACTOR PRICE INDEXES DEVELOPED BY THE COMMISSION FROM COMPANY PRICE LISTS,[1] 1956-68

(1961 = 100)

	1956	1961	1962	1963	1964	1965	1966	1967	1968
Group I (6 models, 4 companies) (30-45 PTO HP)	79.09	100.0	102.91	107.67	109.65	112.72	113.74	116.41	123.72
Group II (4 models, 3 companies) (45-60 PTO HP)	86.85	100.0	106.76	109.28	114.37	115.63	119.15	122.81	130.19
Group III (4 models, 4 companies) (60-75 PTO HP)	85.32	100.0	117.46	119.67	121.19	125.78	126.11	128.20	135.22
Group IV (2 models, 2 companies) (75-90 PTO HP)		100.0	108.14	106.50	112.51	114.34	116.67	121.97	124.98
Group V (4 models, 4 companies) (90-100 PTO HP)		100.0	113.61	120.98	124.18	127.03	129.32	133.93	135.84
Group VI (2 models, 2 companies) (100-115 PTO HP)							124.68[2]	139.23	141.76
Group VII (2 models, 2 companies) (Over 115 PTO HP)				112.82[2]	128.64	132.42	143.09	142.13	146.89
All tractors–									
Equal weights	83.75	100.0	109.77	112.82	118.42	121.32	124.68	129.24	134.09
1968 weights[3]	83.51	100.0	108.63	112.31	116.06	118.81	121.09	124.83	130.85

[1] Twenty-four tractor models in all. Actual company price lists for up to four leading companies (1967) in each group used 1966-68; other years, National Farm & Power Equipment Dealers' Association, *Official Tractor and Farm Equipment Guide* (St. Louis, Mo.), various years.

[2] Entered at average of other tractor groups in year.

[3] Indexes for new entrants also weighted at 1968 weight factors.

point, a predecessor model having the same or similar specifications for cylinder size, separation area, and cleaning area was selected and the series carried back using this predecessor model. Ancillary specifications such as type of table lift, size of table, form of hydraulics, and tire size were kept constant over the period analyzed. The results of this analysis for each combine model studied and an average for the eight models are shown in Table 31.4.

A comparison of the tractor and combine price indexes prepared by the Commission with other available price indexes for tractors and combines is provided in Table 31.5. These other indexes include price indexes for tractors and combines prepared from company price data supplied to the Dominion Bureau of Statistics as a basis for constructing their index of farm machinery prices (as a component of the index of commodities and services used by farmers), indexes based on a survey of farm machinery dealers hitherto unpublished and, for combines only, the industry selling prices sub-index. The official U.S. wholesale price indexes for tractors and combines are also shown. In general, the Commission's indexes show a significantly larger price rise for tractors and combines than that recorded by the data supplied by two companies to DBS. The Commission indexes also rise more than those recorded in the survey of dealers. However, these latter indexes include the effects of allowances off list prices, whereas the Commission's data are for official list price. Thus these two sets of index numbers are not fully comparable. For combines the price recorded in the Commission's index is very much larger than that recorded in the industry selling price index. As was pointed out earlier in this chapter, for farm machinery the latter is predominantly a price at which machines are transferred from one division to another of the same company. As such, the prices have rather limited significance.

The much greater rise shown by the Commission's price indexes for tractors and combines than that shown by data supplied to DBS by the farm machinery companies underlines the need to strengthen the basis of the official indexes and make them less dependent on data supplied by so few companies. The Commission has already discussed this matter with officials of the Dominion Bureau of Statistics.

Except for the dealer indexes all of these prices are suggested retail list prices. The prices actually paid by farmers in 1968 are believed to be about 15 per cent or more below this. In contrast, in 1956 the price paid by farmers was about 95 per cent of the list price. Allowance for this decline in the dealer's margin reduces the increase from 1956-68 in the average price of all tractors from 60 per cent to 43 per cent, and the increase over the same period in the average price of combines from 73 per cent to 55 per cent.

In terms of 1961 prices equalling 100, the index of prices adjusted for changes in dealer margins for 1968 would be 126.6 for tractors and 138.8 for combines. Although these two numbers are somewhat closer to the DBS indexes of 122.5 and 123.6 for these two products, it must be recognized that this result is

TABLE 31.4–COMBINE PRICE INDEXES DEVELOPED BY COMMISSION FROM COMPANY PRICE LISTS FOR EIGHT COMBINE MODELS

(1961 = 100)

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Model 1	76.24	81.86	87.45	94.95	97.22	100.00	107.61	109.74	119.84	123.82	128.55	123.36	133.54	143.39
Model 2						100.00	103.32	106.59	108.54	112.02	114.30	131.39	138.32	149.46
Model 3									117.05[1]	120.47	122.22	117.88	127.42	136.64
Model 4									117.05[1]	119.61	119.61	136.12	142.16	147.40
Model 5	82.63	86.59	91.13	94.54	100.00	100.00	109.51	112.22	118.29	122.46	126.57	131.79	138.87	145.91
Model 6			92.26[1]	95.89	100.00	100.00	109.67	112.90	119.72	124.44	128.61	135.10	146.13	150.90
Model 7				95.86[1]	95.86	100.00	113.77	117.70	119.87	128.16	133.96	139.49	148.90	148.90
Model 8							108.78[1]	112.46	116.03	123.75	126.05	130.59	130.59	150.21
All combines	79.43	84.23	90.28	95.31	98.27	100.00	108.27	111.94	117.05	121.84	124.98	130.71	138.24	146.60

[1] Entered at average of other combines in year.

TABLE 31.5–COMPARISON OF FARM MACHINERY INDEXES: DOMINION BUREAU OF STATISTICS, U.S. BUREAU OF LABOR STATISTICS, AND INDEXES DEVELOPED BY COMMISSION FROM COMPANY PRICE LISTS

(1961 = 100)

	Tractors					Combines				
	DBS		U.S. Bureau of Labor Statistics	Commission from Company Price Lists		DBS			U.S. Bureau of Labor Statistics	Commission from Company Price Lists
	Company Prices	Dealers' Survey	Annual Average[1]			Company Prices	Dealers' Survey	I.S.P.I.[2]	Annual Average[3]	
	(Weighted)			(Equal weights)	(1968 weights)	(Weighted)				(Eight models)
1956	77.0	n.a.	82.5	83.75	83.51	84.4	n.a.	88.1	82.7	80.25
1957	85.1	n.a.	84.4	n.a.	n.a.	85.0	n.a.	91.7	84.0	85.09
1958	88.1	90.2	89.0	n.a.	n.a.	92.7	91.4	96.6	90.1	90.21
1959	93.2	93.8	91.6	n.a.	n.a.	96.9	95.4	97.5	91.4	95.07
1960	96.3	96.0	94.3	n.a.	n.a.	99.7	97.8	98.2	95.0	95.07
1961	100.0	100.0	100.0	100.00	100.00	100.0	100.0	100.0	100.0	100.00
1962	102.6	104.8	108.5	109.77	108.63	104.1	105.6	101.6	107.4	108.95
1963	104.8	109.4	111.4	112.82	112.31	108.1	109.1	103.1	110.2	112.10
1964	107.3	113.8	113.4	108.42	116.06	108.7	112.8	101.8	112.6	117.49
1965	108.3	117.9	116.4	121.32	118.81	110.5	117.2	102.1	117.0	119.48
1966	111.2	123.0	120.1	124.68	121.09	115.0	122.2	105.8	121.1	125.43
1967	116.9	127.1	122.9	129.24	124.83	119.7	125.2	108.0	126.2	131.19
1968	122.5	130.3	127.6	134.09	130.85	123.6	128.6	112.1	132.7	138.72
1969			133.7					116.4	135.2	147.15

[1] Index obtained from unweighted averages of four tractor HP sizes (01-04) reported 1956-60 and continuation of three highest classes plus addition of diesel tractor class (05) 1961-66. Average Index thus obtained converted to Canadian dollars at Bank of Canada average noon rates for the year.

[2] Industry Selling Price Index.

[3] Data provided by U.S. Bureau of Labor Statistics, converted to Canadian dollars at Bank of Canada average noon rates for the year.

entirely fortuitous. The latter indexes are intended to show changes in suggested retail prices rather than changes in the prices actually paid by the farmer.

Finally, it should be noted that the price indexes for combines and tractors prepared by the Commission from company price lists are taken from price lists that appear late in the year. They measure prices that normally apply to the following selling season.

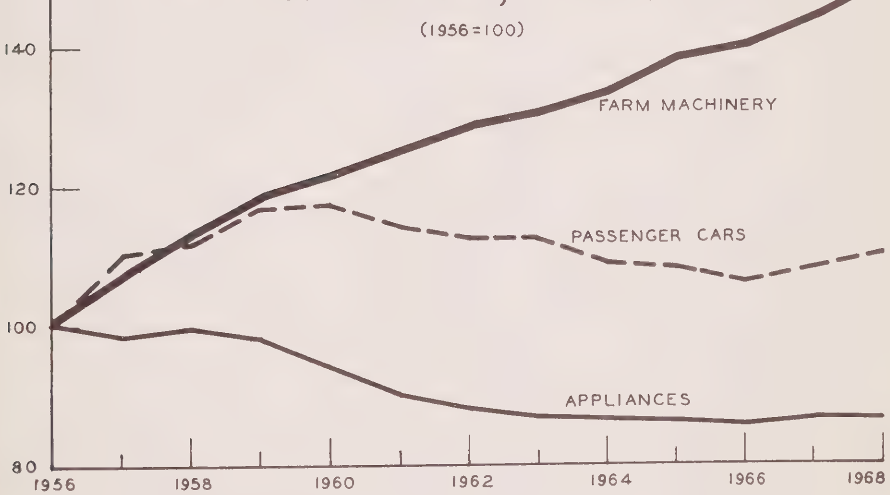
Comparison of Price Changes for Farm Machinery and for Other Durables

Farm machinery prices have increased a great deal more in recent years than the prices of other durable commodities which make use of similar materials and whose producers have experienced roughly similar rates of wage increase. As Figure 31.2 shows, the retail price of passenger cars rose only about 10 per cent between 1956-68. In the same period appliance prices declined about 14 per cent. In contrast, for farm machinery the official index of prices to the farmer increased by almost 50 per cent. Even when allowance is made for the fact that dealer margins declined during this period, the adjusted index still shows a rise of about 34 per cent for farm machinery.

The same pattern also emerges from an examination of the industry selling prices of some of the major products produced by these industries (see Figure

FIGURE 31.2-COMPARISON OF INDEX PRICES TO FINAL BUYER, FARM MACHINERY, APPLIANCES, AND PASSENGER CARS, CANADA, 1956-68

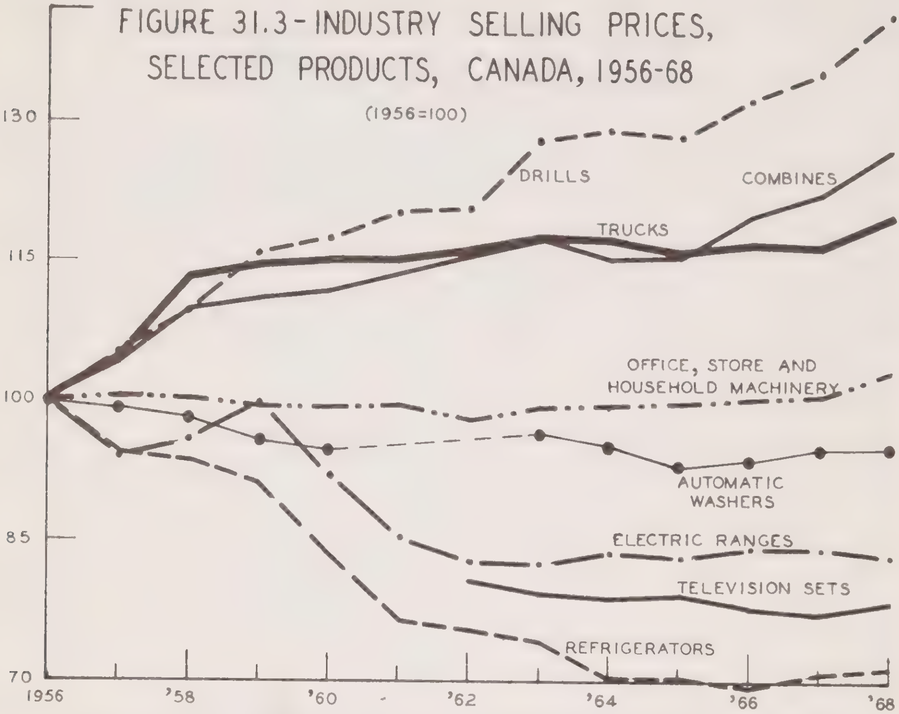
(1956=100)



NOTE: FARM MACHINERY PRICES ARE LIST PRICES AS SHOWN BY INDEX OF COMMODITIES AND SERVICES USED BY FARMERS. PASSENGER CARS AND APPLIANCES PRICES ARE AS REPORTED IN DOMINION BUREAU OF STATISTICS, PRICES AND PRICE INDEXES, 1956-68.

31.3). Television sets, domestic refrigerators, electric ranges, and automatic washers, all declined in price by amounts ranging from 5 to 28.5 per cent between 1956-68. Office, store, and household machinery increased by about 3 per cent, and trucks by some 20 per cent. In the same period the price of combines increased 27 per cent and the price of drills 41.6 per cent.

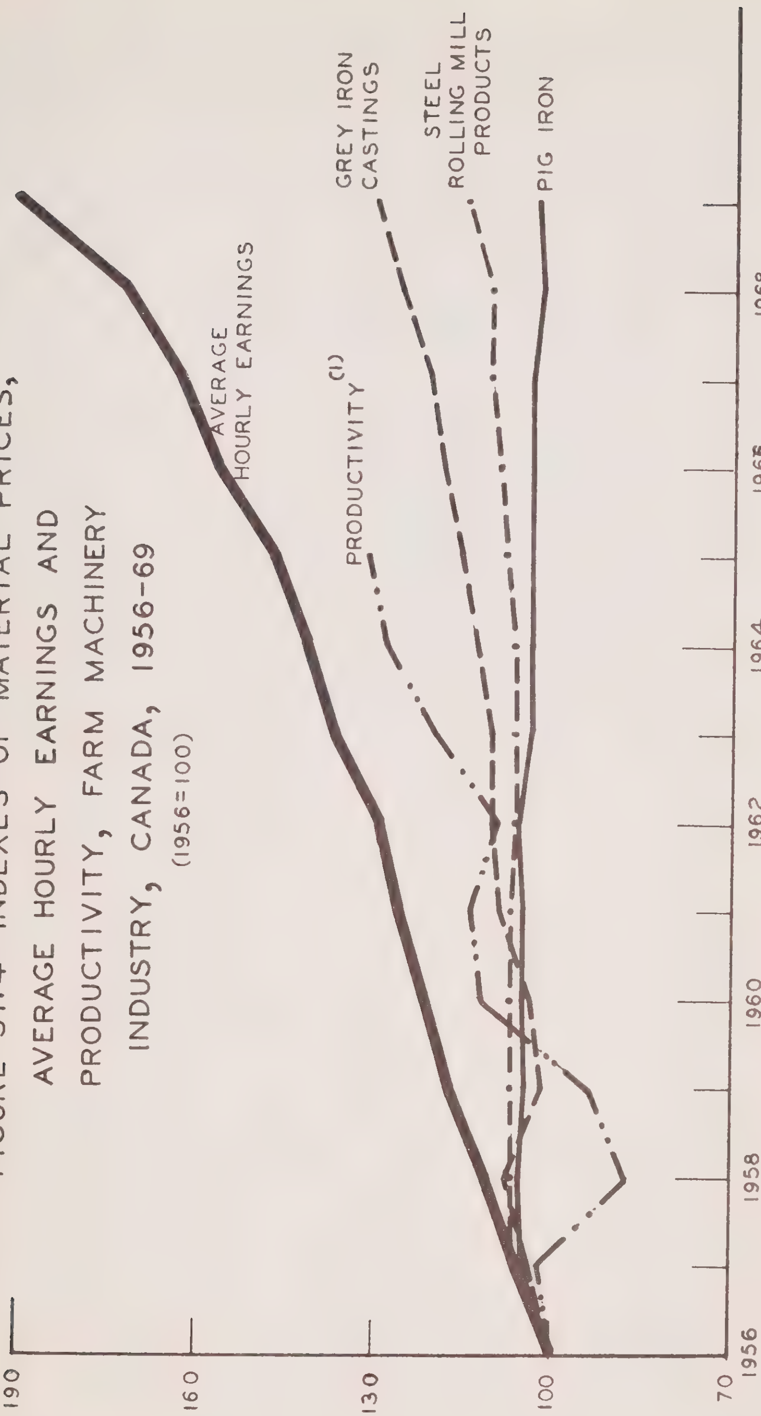
FIGURE 31.3 - INDUSTRY SELLING PRICES, SELECTED PRODUCTS, CANADA, 1956-68



SOURCE: DOMINION BUREAU OF STATISTICS INDUSTRY SELLING PRICE INDEXES 1956-59, CAT. NO. 62-515 AND MONTHLY REPORT PRICES AND PRICE INDEXES, CAT. NO. 62-002.

The cost situation faced by farm machinery manufacturers is illustrated in Figure 31.4. The industry had to absorb an increase in the average hourly earnings paid to production workers of 91 per cent between 1956-69. On the other hand, the increase in the price of some of the industry's basic materials has been very modest. Steel rolling-mill products increased only 15 per cent between 1956-69, and pig iron by only 3 per cent. Significantly larger than this has been the increase in price shown by grey iron castings, almost 31 per cent. Offsetting these cost increases in part has been a substantial rise in productivity. Estimates prepared for the Commission indicate that value added per man-hour paid in the industry, measured in constant dollars, increased by about 32 per cent between 1956-66. However, this estimate must be treated with considerable caution. Industry sales were depressed in the mid-fifties, and the industry's productivity in 1956 was apparently below its level a few years earlier.

FIGURE 31.4 - INDEXES OF MATERIAL PRICES, AVERAGE HOURLY EARNINGS AND PRODUCTIVITY, FARM MACHINERY INDUSTRY, CANADA, 1956-69 (1956=100)



(1) VALUE ADDED IN CONSTANT DOLLARS PER MANHOUR PAID.

SOURCE: DOMINION BUREAU OF STATISTICS, INDUSTRY SELLING PRICE INDEXES 1956-59, CAT. NO. 62-515, AND MONTHLY REPORT PRICES AND PRICE INDEXES, CAT. NO. 62-002.

Having examined this evidence, the question can be raised as to why the prices of the farm machinery industry's products should have increased by so much more than the prices of passenger cars, major appliances, and similar products. Many of the industry's products have become immensely more complicated with the introduction of hydraulics, advanced types of transmissions, diesel engines, sensing mechanisms, and power steering. Similar but less complicated changes have occurred in passenger cars.

A major difference between farm machinery and passenger cars and other similar products is the volume of output available to the manufacturer. As farms get larger, they get fewer in number. These fewer but larger farms require larger machines, but the annual *number* of tractors and other products purchased has been declining. In recent years the North American automobile industry has produced around 8 or 9 million passenger cars. In contrast, total output of farm and industrial wheeled tractors in North America in recent years has been under 250,000. General Motors has an annual output of cars in excess of 5 million. Massey-Ferguson, the world's largest producer of tractors, had an annual output in 1966 of 154,000 units. And while automobile output has been increasing in volume, output of tractors and many other farm machines has been declining. Between 1953-67, output of tractors in North America fell from 390,000 to 242,000. Thus, unlike the automobile industry which has had available to it the economies of scale that go with large-scale output, the farm machinery industry has had to adjust to declining volume. While there is no firm evidence on this question, it seems highly probable that this factor has made it difficult for the farm machinery industry to achieve the same rate of productivity growth as has been possible in the automobile and other industries.

To some degree the industry has tried to adjust to this squeeze, between rising wages and material prices and declining volume, by moving to rationalize their operations more fully on an international basis. The changes that Ford and Massey-Ferguson have made in respect to their tractor operations were described in previous chapters. It seems likely that the industry will see further moves in this direction in the years ahead. Thus, for major products such as tractors and combines, the recent trend towards fewer and larger firms, rationalizing their manufacturing operations on a worldwide basis, is likely to continue.

Prices of Farm Machinery Parts

No official data have been available on the prices of farm machinery parts. To obtain information on what has been happening in this area, it was necessary for the Commission to prepare its own index of parts prices. Unfortunately, data limitations made it necessary to limit this index to the period from 1963-67. In addition, one company was able to supply an index of its own parts prices back to 1959. For three major companies the index was based on a sample of 200 parts, selected to represent both slow- and fast-moving parts. For the fourth company, the company's own index based on complete coverage was used. The breakdown of the sample by different sales volume of parts is given for one company in Table

31.7. An industry index for the period 1963-67 was prepared by weighting the parts-price index of each individual company by the dollar value of its parts sales in 1966. The resulting index and the sub-indexes for each company are given in Table 31.6.

TABLE 31.6–INDEX OF FARM MACHINERY PARTS PRICES, FOUR MAJOR COMPANIES, CANADA, 1963-67

(1963 = 100)

	A	B	C	D	Weighted Index
1963	100.0	100.0	100.0	100.0	100.0
1964	102.7	103.3	100.0	102.2	101.6
1965	98.4	104.3	103.9	105.4	103.8
1966	103.1	103.3	117.4	108.5	110.5
1967	110.0	106.0	125.3	112.3	116.0

Note: Company D also supplied an index covering the years 1959-63 as follows: 1959, 86.6; 1960, 89.1; 1961, 91.8; 1962, 97.0; 1963, 100.0.

TABLE 31.7–SAMPLE SELECTION PROCEDURE FOR FARM MACHINERY PARTS PRICES

Group	Unit Sales Volume	Quantity of Part Numbers in Groups	Percentage of Dollars Sales	Size of Sample (Part Numbers)	Sampling Ratio
1	5,000 and over	885	24.7	32	1/28
2	3,000 to 4,999	606	9.2	11	1/55
3	1,000 to 2,999	2,300	17.1	34	1/68
4	500 to 999	2,595	12.1	25	1/104
5	300 to 499	2,429	7.7	17	1/143
6	100 to 299	7,675	14.1	51	1/150
7	1 to 99	53,830	15.3	30	1/1,794

Source: Data show sampling method as applied to one responding company.

The weighted index of four companies shows an increase in parts prices of 16 per cent between 1963-67. This is appreciably more than the 10.4 per cent increase during this period registered for the list price of farm machinery. However, there was a marked variation in the price increase reported for the four different companies. Thus, for three companies, A, B, and D, the increase over this period ranged from 6 to 12.3 per cent. The fourth company, C, reported a price rise of 25.3 per cent, more than twice as much as for any other single company. This company claimed that some of its price increase reflected the delayed effects of the devaluation of the Canadian dollar. Almost all of this change occurred between 1965-67, and it affected both slow- and fast-moving parts. However, prices of the fastest-moving parts, those in Group 1 (Table 31.7) which would be subject to the

most competition from the "well-fit" manufacturers, increased by only 13 per cent, or by less than half the amount recorded for most other groups.

The one company that reported changes in its parts prices over the longer period from 1959-67 registered a 30 per cent rise in its parts prices over this period. This compares with a 22 per cent rise in the price of farm machinery over this period. Thus, for both the shorter period from 1963-67 and the longer period from 1959-67, there is evidence that prices of farm machinery parts have risen by more than the prices of new machinery.

It is recommended that the Dominion Bureau of Statistics take over and publish on a regular basis the parts price index that was initiated by the Commission.

Any explanation as to why the prices of parts have risen more in recent years than the prices of finished machines must be to some degree speculative. According to Massey-Ferguson, non-competitive parts—those that fit Massey-Ferguson machines only—are priced by establishing a list price of about three times factory cost.[1] This price may be varied if the pricing specialist deems it out of line with the price of other similar parts. On competitive parts, consideration is also given to the price at which the part may be obtained from other suppliers.

An analysis of the price increase in parts from 1963-67 provides some evidence that the slower-moving parts have increased more in price than the faster-moving parts. However, this pattern is not completely uniform. The data, ranked in order from fast- to slow-moving parts, are as follows for an unweighted average of the price increase reported by three major companies:

	Per cent		Per cent
Group 1	9	Group 5	11
" 2	11	" 6	15
" 3	13	" 7	19
" 4	18	All groups	14

Thus, the two fastest-moving groups, namely 1 and 2, showed price increases of 9 and 11 per cent, whereas the two slowest-moving groups, 6 and 7, registered increases of 15 and 19 per cent. Since the slower-moving groups presumably contain a good many parts for older machines, there must have been a systematic repricing for many of these parts. A number of companies reported that it costs them about 15 per cent of the value of a stock of parts to carry them for one year. This includes the interest cost on the money invested, the cost of warehousing, and the cost of tagging, cleaning, and oiling parts. Thus, for the slower-moving parts which are manufactured only every few years, or where lifetime requirements for a part are manufactured at one time, there would be a gradual increase in cost over a period of years. However, this 15 per cent would presumably only apply to the

[1] Massey-Ferguson Industries Limited, *Brief to the Royal Commission on Farm Machinery*, Ottawa, January 8, 1968, Vol. II, Ch. VI.

manufacturing cost, which is estimated at about one-third of selling price. In practice, automatic use of this pricing formula may result in the list price being advanced in line with the increase in cost.

An international comparison of the rise in farm machinery prices over the past decade in Canada, the United States, a number of countries in Western Europe, Australia, and Japan, is provided in Table 31.8. Because inflation has occurred at varying rates in different countries, comparisons are made both in current currency values and in constant currency values—that is, for an index adjusted by the rise in consumer prices in each country. An examination of these data shows widely divergent rates of price rise, ranging from almost no change in Italy to an increase of 56 per cent in Belgium. The rise in Canada is somewhat on the high side of the range, being exceeded by 5 of the 14 countries included. In terms of the constant currency values measure, a similar divergence in results is evident. The range is from a reduction of about 28 per cent in Italy to a rise of almost 25 per cent in Belgium. The rise in Canada is about 15 per cent, being exceeded by only two of the other countries in the group. Not too much emphasis should be placed on this comparison because little information is available about the construction and comparability of the various indexes.

Until recently the farm machinery component of the DBS *Price Index Numbers of Commodities and Services Used by Farmers* was an index of the suggested retail list prices of a selected number of farm machines. Price data were supplied by just two companies. Prices included some freight charges. Currently, prices are collected from a sample of farm machinery dealers as well. Although for this index an attempt is made to collect actual transaction prices, the Dominion Bureau of Statistics believes that in many instances list prices are reported.

In view of the widespread interest that attaches to farm machinery price indexes, it is recommended that (1) coverage be improved by collecting data on a larger number of machines; (2) sub-indexes for tractors, combines, and some other major machine groups be published separately; (3) for the dealer price index, in view of the uncertainty of the nature of the price data now being collected, DBS collect both list price data and an estimate of the cash discount from list that would be allowed on a sale not involving a trade-in; and (4) the parts price index which was initiated by the Commission be taken over and incorporated in the *Price Index Numbers of Commodities and Services Used by Farmers.*

It was noted above that the present selling price index for farm machinery is largely an index of transfer prices between different branches of the same company. It has no clear meaning as a measure of market prices. Accordingly, it is recommended that DBS also collect and publish an index of wholesale or dealer prices for farm machinery.

The farmer often does not know the suggested list price for the machine he is considering buying. As a result, the dealer may quote a price above list as his starting point for bargaining, thus placing the farmer at a disadvantage. There is no

TABLE 31.8–INTERNATIONAL COMPARISON OF PRICE INDEXES OF FARM MACHINERY, SELECTED COUNTRIES, IN CURRENT AND CONSTANT CURRENCY VALUES, 1956-67

	With Current Currency Values				With Constant Currency Values			
Country	1956	1965	1966	1967	1956	1965	1966	1967
Canada (Canadian $)	100	136.1	140.0	144.3	100	115.8	114.9	114.4
United States	100	125.1	128.8	133.0	100	107.8	107.9	108.4
Britain	100	124.2	–	–	100	96.5	–	–
France	100	145.2	147.4	149.6	100	92.9	91.8	90.7
Italy	100	98.3	99.6	–	100	72.9	72.2	–
Austria	100	133.7	142.1	146.2	100	101.8	107.2	105.6
West Germany	100	122.7	125.7	122.4	100	100.2	99.2	95.2
Belgium	100	147.5	156.0	159.0	100	122.7	124.6	123.4
Finland	100	152.3	–	–	100	110.7	–	–
The Netherlands	100	119.8	–	–	100	90.6	–	–
Norway	100	121.7	123.5	129.1	100	90.8	88.8	89.0
Switzerland	100	135.6	141.6	145.7	100	110.7	110.3	109.2
Australia	100	129.4	132.1	–	100	116.8	115.7	–
Japan	100	108.6	111.4	–	100	75.4	75.3	–

Source: FAO *Production Yearbook*, 1968 and earlier issues and Statistical Office of the European Economic Community, *Agricultural Statistics*, 1967. Indexes were converted to a 1956 base by mechanical means. Most indexes are for farm machinery including tractors. Data for Britain are for tractors only and are taken from A. J. Rayner, "Price-Quality Relationships in a Durable Asset: Estimation of a Constant Quality Price Index for New Farm Tractors, 1948-1965", *Journal of Agricultural Economics*, Vol. XIX, No. 2, May 1968, p. 241. Indexes in constant currency values were obtained by dividing the index in current currency values by an index of consumer prices for the country concerned.

reason why information on list prices should not be available to the farmer. Two remedies are suggested. The first is to have the companies attach, at the factory, an invoice giving the suggested retail price for all machines priced above a certain level, say $500. This invoice would list the retail price of the basic machine and the price of optional attachments for the unit in question. At least one major company already does this. In the United States, automobile manufacturers are required by federal law to attach such retail price invoices to their vehicles and dealers are forbidden to remove them before the sale is made.

An alternative would be to require the farm machinery companies to publish the list prices of their machines and make the publication freely available to farmers. In other countries such as Britain, France, West Germany, Italy, and Australia this information is already being made available to farmers.

For repair parts, complaints from farmers and discussions with major companies indicate that dealers may often sell above the suggested list price. The farm machinery companies contend that this practice is pretty well impossible to prevent. One solution to this problem would be to give the farmer the right to inspect the dealer's parts price book to determine whether or not he is being charged the list price.

Accordingly, it is recommended that the government require farm machinery companies to attach invoices to all machines with a list price in excess of $500, giving the company's suggested retail price for each machine, *or* publish general price lists providing the same information. It is further recommended that the farmer be given the right to inspect the dealer's parts price list whenever he feels he is being overcharged for a part.

APPENDICES

Appendix A
SELECTED STATISTICAL DATA

TABLE A.1–WORLD PRODUCTION AND STOCK OF TRACTORS, SELECTED YEARS, 1951-66

(In thousands of units)

	Africa		Asia		Europe		Latin America		United States and Canada		Oceania		U.S.S.R.		Total World	
	Stock[1]	Production	Stock	Production	Stock	Production	Stock	Production	Stock[3]	Production	Stock	Production	Stock	Production	Stock	Production
1951	100.0	n.a.	40.0	n.a.	1,100.0	209.8[2]	149.3	n.a.	4,077.7	559.2[2]	192.0	4.0[2]	591.5[5]	n.a.	6,250.5	773.0[2]
1961	221.0	n.a.	144.0	n.a.	3,764.0	465.5	395.2	n.a.	5,244.8	191.2[4]	349.0	n.a.	1,212.0	n.a.	11,330.0	745.9
1963	279.5	n.a.	175.5	n.a.	4,394.6	473.0	415.4	n.a.	5,299.3	224.3	372.8	n.a.	1,442.0	n.a.	12,379.0	697.3
1964	296.3	n.a.	192.9	n.a.	4,677.1	471.2	453.6	n.a.	5,334.0	240.6	387.7	n.a.	1,539.0	n.a.	12,880.7	732.5
1965	310.6	n.a.	206.8	n.a.	4,958.2	496.9	480.8	n.a.	5,371.7	271.6	395.2	n.a.	1,613.0	n.a.	13,336.3	789.4
1966	327.7	n.a.	236.5	n.a.	5,243.6	492.1	512.1	n.a.	5,398.5	299.1	406.1	n.a.	1,660.0	n.a.	13,784.5	822.8

[1] Includes South Africa; without South Africa totals are 1951, 52; 1961, 102; 1963, 109; 1964, 116; 1965, 121; 1966, 128 (Table 19.19).
[2] Data are for 1950.
[3] Canadian data given only for census years, interpolated on straight line basis. Totals for Canada and United States taken from Dominion Bureau of Statistics, *Census of Canada 1966, Agriculture*, and United States Department of Agriculture, *Agricultural Statistics, 1967*; other data taken from FAO *Production Yearbook*, various years. World totals, therefore, will not correspond to FAO totals.
[4] Contractors' off-highway tractors are included until 1954.
[5] U.S.S.R. data for 1951 were given in 15 HP units, therefore, given total 971.1 was reduced.

Source: United States Department of Agriculture, *Agricultural Statistics, 1967*; DBS, *Census of Canada 1966, Agriculture*; FAO *Production Yearbook* and O.E.C.D., various years, and R. E. Linneman, *The United States Tractor Industry in Selected Foreign Markets*, 1964.

TABLE A.2–ESTIMATES OF TOTAL AND AVERAGE HORSEPOWER[1] OF WHEEL-TYPE FARM TRACTORS SOLD AT RETAIL LEVEL, 1945-68

	Canada		Prairies		Ontario	
	Total HP ('000)	Average HP	Total HP ('000)	Average HP	Total HP ('000)	Average HP
1945	352	19.3	–	–	–	–
1946	398	18.3	234	19.8	–	–
1947	647	19.3	410	22.0	–	–
1948	856	19.0	535	21.8	–	–
1949	1,206	19.4	738	21.3	–	–
1950	1,115	20.0	669	23.4	–	–
1951	1,110	22.2	587	27.0	–	–
1952	1,057	24.0	638	30.1	–	–
1953	1,130	28.9	682	33.6	–	–
1954	734	29.0	404	35.5	–	–
1955	793	30.7	351	36.1	–	–
1956	1,003	42.5	509	50.6	–	–
1957	931	42.8	479	52.0	207	37.0
1958	1,027	44.3	537	54.3	237	38.1
1959	1,177	46.3	615	55.9	263	37.4
1960	1,207	47.5	676	58.7	265	40.5
1961	1,117	47.5	583	60.8	251	39.2
1962	1,176	49.5	645	61.6	254	42.0
1963	1,390	53.9	836	66.9	265	43.9
1964	1,559	56.7	1,010	70.1	307	44.8
1965	1,608	59.9	1,043	74.0	332	48.1
1966	1,909	62.5	1,212	78.2	408	49.9
1967	1,879	63.0	1,108	80.4	437	52.3
1968	1,447	62.6	683	83.2	389	53.4

[1] Earlier years adjusted to approximate maximum observed PTO horsepower at maximum engine r.p.m. equivalent to actual data reported, 1961 to date.

Source: Estimates based on Dominion Bureau of Statistics, *Farm Implement and Equipment Sales,* Cat. No. 63-203 (Ottawa: Queen's Printer), 1945-68; Nebraska Test ratings, University of Nebraska, and company returns to DBS.

TABLE A.3–FARM MACHINERY INDUSTRY, CANADA, 1947-66

	Value of Shipments $ Million		Value Added $ Million		Production Workers	Total Employees	Wages	Wages and Salaries	Costs of Materials, Fuel and Electricity	Capital Expenditures	Paid Man-hours of Production Workers
	(Current $)	(Constant $)	(Current $)	(Constant $)	(Numbers)	(Numbers)	($ Million)	($ Million)	($ Million)	($'000)	('000)
1947	102.0	197.7	49.4	95.7	13,688	16,013	26.0	31.2	51.3	n.a.	n.a.
1948	167.7	278.1	82.0	136.0	15,510	18,747	36.3	45.3	83.6	6,170	33,874
1949	202.0	294.5	102.4	149.3	13,860	17,074	34.7	44.2	97.8	4,237	29,622
1950	170.6	237.3	88.4	122.9	13,161	16,223	33.9	43.3	81.1	3,341	26,896
1951	195.3	265.4	94.0	127.7	14,038	17,236	41.5	52.2	98.5	4,266	28,761
1952	234.8	272.7	121.3	140.9	14,753	18,046	49.7	62.4	111.9	6,223	30,226
1953	195.5	201.5	102.3	105.5	10,989	14,161	37.4	50.3	92.1	4,226	22,229
1954	135.8	157.7	63.6	73.9	8,949	11,805	28.5	40.2	68.4	3,005	18,335
1955	130.0	135.7	70.5	73.6	8,952	11,753	30.7	41.9	61.0	2,402	18,481
1956	140.0	140.0	66.6	66.6	7,271	9,838	25.9	36.7	66.7	3,455	15,031
1957	139.8	134.7	75.3	72.5	7,318	9,725	26.8	37.6	60.0	4,064	16,617
1958	147.4	136.2	75.3	69.6	7,989	10,526	33.1	45.8	77.7	5,290	17,380
1959	189.6	172.2	98.1	89.1	10,169	13,056	44.2	60.0	101.6	3,587	21,363
1960	181.0	162.8	89.5	80.5	7,879	10,924	35.2	52.7	80.4	5,976	16,142
1961	160.6	141.7	82.0	72.4	6,986	10,058	31.1	46.3	75.9	7,782	14,309
1962	162.1	140.7	85.0	73.8	7,331	9,949	34.9	48.9	78.5	3,013	15,182
1963	211.7	180.8	114.9	98.1	8,623	11,160	44.1	58.4	99.5	14,360	18,354
1964	272.2	233.0	136.2	116.6	9,569	12,474	51.5	68.5	137.7	18,725	20,488
1965	316.1	269.3	152.9	130.2	10,599	13,721	56.3	75.6	165.3	12,507	22,310
1966	364.3	299.8	172.2	141.7	11,332	14,498	64.2	85.3	193.3	11,269	24,248

Note: All dollar values are current dollars unless otherwise stated.

Source: C. J. Maule, *Productivity in the Farm Machinery Industry*, Royal Commission on Farm Machinery, Study No. 3 (Ottawa: Queen's Printer 1969), Table A5, p. 63.

TABLE A.4–FARM MACHINERY INDUSTRY, UNITED STATES, 1947-66

(Values given in Canadian dollars)[1]

	Value of Shipments $ Million		Value Added $ Million		Production Workers	Total Employees	Wages	Wages and Salaries	Costs of Materials, Fuel and Electricity	Capital Expenditures	Paid Man-hours of Production Workers	Exchange Rate Canadian Cents per U.S. Dollars
	(Current $)	(Constant $)	(Current $)	(Constant $)	(Numbers)	(Numbers)	($ Million)	($ Million)	($ Million)	($'000)	('000)	
1947	1,457.3	2,055.4	633.8	893.9	116,871	143,446	317.2	412.3	823.7	82,904	247,346	100
1948	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	100
1949	1,958.2	2,306.5	883.5	1,040.6	116,273	145,499	371.8	505.7	1,073.8	44,441	237,616	103
1950	2,062.1	2,378.4	956.4	1,103.1	108,898	137,807	372.8	507.6	1,105.8	39,102	227,074	109
1951	2,489.2	2,645.3	1,097.0	1,165.8	121,680	152,957	459.3	610.6	1,392.2	49,556	257,524	105
1952	2,284.5	2,397.2	1,031.9	1,082.8	110,616	142,603	408.9	563.7	1,254.6	51,081	229,506	98
1953	2,139.3	2,230.8	950.1	990.7	98,708	129,565	387.7	543.4	1,189.2	58,272	204,286	98
1954	1,593.0	1,662.8	740.1	772.6	78,959	104,416	303.9	434.9	842.6	47,100	162,182	97
1955	1,886.3	1,952.7	898.2	929.8	87,836	114,001	358.3	504.1	1,029.0	49,108	184,983	99
1956	1,746.5	1,746.5	834.3	834.3	79,423	104,563	318.2	462.6	955.9	39,673	165,200	98
1957	1,898.4	1,813.2	879.2	839.7	81,462	108,368	338.7	492.8	1,061.6	40,344	168,170	96
1958	2,349.2	2,155.2	1,055.2	968.1	79,922	108,586	362.0	534.5	1,278.8	48,286	164,160	97
1959	2,457.1	2,186.0	1,125.3	1,001.2	84,803	113,153	407.0	593.1	1,392.7	43,727	178,595	96
1960	2,097.7	1,830.5	912.8	796.5	71,110	99,115	345.3	524.0	1,127.2	53,751	147,169	97
1961	2,362.9	2,204.8	1,067.7	914.9	76,371	102,538	385.8	585.1	1,264.1	46,405	159,249	101
1962	2,655.7	2,231.7	1,290.3	1,084.3	77,139	106,222	441.9	661.5	1,428.5	46,009	162,856	107
1963	3,069.6	2,541.1	1,434.7	1,187.7	84,650	112,614	514.9	744.2	1,659.7	69,585	179,153	108
1964	3,460.4	2,820.2	1,648.2	1,343.3	90,215	118,621	581.4	831.5	1,884.8	90,282	194,215	108
1965	3,812.0	3,047.2	1,816.9	1,452.4	93,941	123,241	618.9	819.0	2,017.2	101,127	202,236	108
1966	4,678.6	3,632.5	2,221.7	1,724.9	105,181	137,341	733.7	966.3	2,551.2	127,060	n.a.	108

Note: All dollar values are current dollars unless otherwise stated.

[1] All U.S. dollar values have been converted to Canadian dollars by use of the exchange rate shown in last column.

Source: C. J. Maule, *Productivity in the Farm Machinery Industry,* Royal Commission on Farm Machinery, Study No. 3 (Ottawa: Queen's Printer 1969), Table A6, p. 64.

TABLE A.5–NET TRADE BALANCE ALL FARM EQUIPMENT AND SELECTED COMMODITIES,[1]
CANADA–WORLD, 1945-69

(Millions of Canadian dollars)

	All Farm Equipment	Tractors and Parts	Combines and Parts	Other Equipment
1945	(30.3)	(33.0)	(0.9)	3.6
1946	(39.7)	(45.1)	1.6	3.8
1947	(63.2)	(63.4)	2.1	1.9
1948	(66.2)	(77.9)	13.4	1.7
1949	(84.0)	(110.1)	16.4	9.7
1950	(72.9)	(99.0)	15.3	10.8
1951	(87.6)	(116.0)	19.6	8.8
1952	(91.9)	(109.5)	5.5	12.1
1953	(134.8)	(119.9)	(5.9)	(9.0)
1954	(66.4)	(76.9)	17.9	(7.4)
1955	(100.8)	(111.6)	14.9	(4.1)
1956	(164.6)	(156.1)	9.2	(17.7)
1957	(132.5)	(125.3)	10.8	(18.0)
1958	(100.7)	(113.5)	23.6	(10.8)
1959	(159.1)	(167.6)	22.1	(13.6)
1960	(141.0)	(127.4)	13.3	(26.9)
1961	(126.9)	(126.7)	14.1	(14.3)
1962	(142.8)	(132.0)	3.4	(14.2)
1963	(185.2)	(175.4)	(0.7)	(9.1)
1964	(180.9)	(173.9)	18.3	(25.3)
1965	(183.7)	(188.0)	35.2	(30.9)
1966	(223.8)	(214.1)	26.2	(35.9)
1967	(214.5)	(217.2)	40.5	(37.8)
1968	(174.0)	(177.9)	45.3	(41.4)
1969	(155.5)	(151.5)	39.8	(43.8)

Note: Figures in brackets indicate a negative trade balance.

[1] All figures include re-exports where data were available. The inclusion of re-exports in the data has the effect of understanding the negative trade balance by the amount of re-exports.

Source: Dominion Bureau of Statistics, *Trade of Canada, Exports by Commodities,* Cat. No. 65-004 (Ottawa: Queen's Printer), 1945-69. DBS, *Trade of Canada, Imports by Commodities,* Cat. No. 65-007 (Ottawa: Queen's Printer), 1945-69.

TABLE A.6–DOMESTIC SALES OF FARM IMPLEMENTS AND REPAIR PARTS, AND IMPORTS OF FARM MACHINERY FROM ALL COUNTRIES AND FROM THE UNITED STATES AS A PERCENTAGE OF DOMESTIC SALES, 1936-68

	Sales of Farm Implements and Repair Parts	Imports of Farm Machinery from All Countries, Including the United States as Percentage of Sales		Imports of Agricultural Machinery from the United States	Imports of Agricultural Machinery from the United States as Percentage of Sales
	($ Million)	($ Million)	(Per cent)	($ Million)	(Per cent)
1936	19.7	9.4	47.7	8.8	44.7
1937	31.3	17.2	55.0	16.3	52.1
1938	42.8	20.3	47.4	19.2	44.9
1939	40.3	20.9	51.9	20.1	49.9
1940	56.4	30.7	54.4	30.2	53.5
1941	61.6	31.0	50.3	30.7	49.8
1942	59.6	23.6	40.0	23.6	39.6
1943	44.6	20.2	45.3	20.2	45.3
1944	71.9	40.6	56.5	40.5	56.3
1945	83.0	50.4	60.7	50.1	60.4
1946	102.5	68.4	66.7	67.7	66.0
1947	145.7	105.4	72.3	104.6	71.8
1948	197.7	140.0	70.8	137.4	69.5
1949	245.2	177.2	72.3	173.1	70.6
1950	248.0	161.6	65.2	152.6	61.5
1951	264.4	195.1	73.8	187.6	71.0
1952	281.5	197.3	70.1	190.1	67.5
1953	269.9	209.1	77.5	202.8	75.1
1954	174.0	143.2	82.3	136.8	78.6
1955	181.6	178.2	98.1	173.1	95.3
1956	202.6	232.1	114.6	226.7	111.9
1957	183.7	202.2	110.1	194.3	105.8
1958	206.0	198.3	96.3	189.9	92.2
1959	251.1	273.8	109.0	254.9	101.5
1960	258.8	212.3	82.0	195.6	75.6
1961	241.4	213.4	88.4	193.7	80.2
1962	282.7	234.3	82.9	211.1	74.7
1963	337.6	299.8	88.8	273.9	81.1
1964	380.1	330.5	87.0	307.2	80.8
1965	427.0	354.4	83.0	329.0	77.0
1966	478.9	413.6	86.4	378.8	79.1
1967	494.3	418.4	84.6	377.7	76.4
1968	442.1	353.2	79.9	312.5	70.7

Note: Because of different valuation levels, i.e. sales figures are actual sales to farmers, imports figures include dealer inventories, the data for imports may be overstated somewhat. In addition, sales figures are valued at a price less the dealer trade discount. Imports figures are valued, typically, at a transfer price between farm machinery company affiliates. In relation to the Suggested Retail Price, the transfer price may be as much as 16 per cent lower than the price less the dealer trade discount.

Source: Dominion Bureau of Statistics, *Farm Implement and Equipment Sales,* Cat. No. 63-203 (Ottawa: Queen's Printer), 1936-68.
DBS, *Trade of Canada, Imports by Commodities,* Cat. No. 65-007 (1944-1968) and 65-D-02 (1936-1944).

TABLE A.7–TOTAL VALUE OF FARM MACHINERY MANUFACTURES AND EXPORTS OF FARM MACHINERY TO ALL COUNTRIES AND TO THE UNITED STATES AND CANADA, 1900, 1910, 1923, 1928-30, 1937-39, 1946-67

	Million of Canadian Dollars				
	Total Production[1]	Exports To All Countries[5]	Exports To United States[5]	Exports To All Others	Domestic Consumption
1900	10.3	1.7[2]		1.7	8.6
1910	23.0	4.3[3]	0.1[3]	4.2	18.7
1923	26.0	6.1[4]	1.3[4]	4.8	19.9
1928	41.2	14.5	3.5	11.0	26.7
1929	40.7	19.8	5.1	14.7	20.9
1930	26.9	10.3	2.7	7.6	16.6
1937	19.0	9.8	3.3	6.5	9.2
1938	21.3	7.8	2.5	5.3	13.5
1939	16.0	7.0	1.9	5.1	9.0
1946	54.0	28.7	14.5	14.2	25.3
1947	83.9	42.2	23.5	18.7	41.7
1948	139.1	73.8	50.6	23.2	65.3
1949	169.6	92.5	70.2	22.3	77.1
1950	141.7	87.8	70.7	17.1	53.9
1951	162.3	106.4	83.5	22.9	55.9
1952	194.7	105.4	83.7	21.7	89.3
1953	159.9	74.3	58.1	16.2	85.6
1954	113.1	76.8	53.3	23.5	36.3
1955	109.7	76.0	63.4	12.6	33.7
1956	117.7	67.5	55.6	11.9	50.2
1957	117.9	69.7	59.4	10.3	48.2
1958	129.1	97.6	90.3	7.3	31.5
1959	152.0	114.7	109.6	5.1	37.3
1960	140.7	85.4	79.6	5.8	55.3
1961	120.8	85.5	76.0	9.5	35.3
1962	122.5	91.5	82.7	8.8	31.0
1963	155.0	114.6	104.8	9.8	40.4
1964	190.9	140.7	127.7	13.0	50.2
1965	220.5	161.9	145.0	16.9	58.6
1966	258.7	182.5	171.6	10.9	76.2
1967	259.2	194.3	184.1	10.2	64.9

[1] See M.C. Urquhart and K.A.H. Buckley (eds), *Historical Statistics of Canada* (Toronto: The Macmillan Company of Canada, 1965), for years 1900-1923; also calendar year factory shipments as reported in Dominion Bureau of Statistics, *Agricultural Implement Industry*, Cat. No. 42-202 (Ottawa: Queen's Printer, various years), for years 1928-67.

[2] Minister of Customs, *Table of Trade and Navigation of the Dominion of Canada*, Sessional Papers No. 11, for the fiscal year ending June 30, 1900.

[3] Minister of Customs, *Table of Trade and Navigation of the Dominion of Canada*, Sessional Papers No. 11, for the fiscal year ending March 31, 1910.

[4] DBS, *Trade of Canada Fiscal Year Ending* March 31, 1923.

[5] DBS, *Trade of Canada (Imports for Consumption and Exports) Calendar Year*, for years 1928-39, various years and DBS, *Trade of Canada Volume 1: Summary and Analytical Tables*, for years 1946-67, various years.

TABLE A.8–INDEX OF PRICES PAID BY FARMERS FOR FARM MACHINERY, CANADA, 1913-69

(1935-39 = 100)

1913	54.6	1931	94.9	1951	186.8
1914	55.0	1932	94.1	1952	195.4
1915	54.4	1933	92.1	1953	196.7
		1934	94.6	1954	197.9
1916	55.1	1935	95.5	1955	198.8
1917	62.0				
1918	82.1	1936	97.8	1956	209.4
1919	86.9	1937	97.2	1957	223.8
1920	92.2	1938	104.1	1958	236.1
		1939	103.6	1959	247.8
1921	111.4	1940	105.8	1960	253.5
1922	89.9				
1923	92.9	1941	109.1	1961	260.7
1924	102.4	1942	114.4	1962	268.1
1925	97.9	1943	117.1	1963	272.9
		1944	118.2	1964	279.6
1926	97.6	1945	115.1	1965	284.9
1927	97.5				
1928	97.6	1946	118.8	1966	293.1
1929	97.5	1947	126.3	1967	302.2
1930	97.0	1948	141.6	1968	313.7
		1949	158.3	1969	324.1
		1950	165.1		

Source: Dominion Bureau of Statistics, Prices Division, July 19, 1968. Canada Department of Agriculture, *Canadian Farm Economics*, various editions.
DBS, *Prices and Price Indexes*, Cat. No. 62-002 (Ottawa: Queen's Printer, December 1969).

TABLE A.9–MACHINERY OPERATING AND DEPRECIATION EXPENSES, AND MACHINERY OPERATING AND DEPRECIATION EXPENSES AS A PERCENTAGE OF TOTAL FARM OPERATING AND DEPRECIATION EXPENSES, CANADA, 1926-69

	Thousands of Canadian Dollars						Percentages of Total Farm Operating and Depreciation Expenses				
	Machinery Operating Expenses			Depreciation Expense on Machinery	Total Machinery Operating and Depreciation Expenses	Total Farm Operating and Depreciation Expenses	Machinery Operating Expenses			Depreciation Expense on Machinery	Total Machinery Operating and Depreciation Expenses
	Repairs	Fuel and Lubricants[1] All Other[1]	Total				Repairs	Fuel and Lubricants[1] All Other[1]	Total		
1926	17,094	53,370	70,464	55,431	125,895	584,842	3	9	12	10	22
1927	17,803	58,338	76,141	60,642	136,783	611,895	3	9	12	10	22
1928	17,876	66,267	84,143	67,046	151,189	639,736	3	10	13	10	23
1929	16,697	73,596	90,293	72,860	163,153	632,207	3	11	14	12	26
1930	16,395	73,899	90,294	69,426	159,720	590,766	3	12	15	12	27
1931	11,795	65,145	76,940	59,813	136,753	498,914	3	12	15	12	27
1932	12,818	58,951	71,769	56,252	128,021	448,539	3	13	16	13	29
1933	12,512	55,279	67,791	53,182	120,973	430,912	3	13	16	12	28
1934	13,831	61,746	75,577	50,120	125,703	453,619	3	14	17	11	28
1935	16,302	58,637	74,939	48,101	123,040	464,782	3	13	16	10	26
1936	15,353	59,397	74,750	47,167	121,917	474,620	3	13	16	10	26
1937	15,728	61,751	77,479	47,391	124,870	497,835	3	12	15	10	25
1938	17,846	65,746	83,592	49,022	132,614	494,873	4	13	17	10	27
1939	19,177	73,326	92,503	49,390	141,893	513,548	4	14	18	10	28
1940	19,917	79,669	99,586	51,662	151,248	528,544	4	15	19	10	29
1941	20,416	89,998	110,414	54,434	164,848	565,037	4	16	20	9	29
1942	27,891	97,033	124,924	60,215	185,139	690,163	4	14	28	9	27
1943	31,478	99,244	130,722	65,820	196,542	770,829	4	13	17	8	25
1944	36,000	104,381	140,381	69,004	209,385	814,162	4	13	17	9	26
1945	39,060	108,422	147,482	75,341	222,823	829,374	5	13	18	9	27

1946	42,952	119,725		162,677	82,630	245,307	928,606	4	13		17	9	26
1947	47,386	132,276		179,662	94,089	273,751	1,065,874	4	13		17	9	26
1948	54,062	166,387		220,449	110,236	330,685	1,179,134	5	14		19	9	28
1949	55,999	192,154		248,153	131,416	379,569	1,232,810	5	15		20	11	31
1950	n.a.	n.a.	n.a.	267,060	157,129	424,189	1,316,183				20	12	32
1951	85,574	153,330	47,083	285,987	181,132	467,119	1,466,194	6	11	3	20	12	32
1952	92,940	164,676	49,105	306,721	197,175	503,896	1,542,264	6	11	3	20	13	33
1953	94,726	175,947	49,448	320,121	217,888	538,009	1,554,611	6	12	3	21	14	35
1954	81,015	183,826	49,170	314,011	230,504	544,515	1,557,694	5	12	3	20	15	35
1955	84,294	194,152	50,619	329,065	226,243	555,308	1,622,055	5	12	3	20	14	34
1956	94,278	203,918	52,998	351,194	225,748	576,942	1,739,077	5	12	3	20	13	33
1957	99,839	209,599	54,764	364,202	238,041	602,243	1,736,230	6	12	3	21	14	35
1958	100,336	211,790	58,171	370,297	247,085	617,382	1,850,073	5	12	3	20	13	33
1959	114,791	212,872	60,952	388,615	255,818	644,433	1,961,016	6	12	3	21	14	35
1960	122,007	212,804	63,932	398,743	265,059	663,802	2,038,947	6	11	3	20	13	33
1961	116,574	209,923	65,504	392,001	266,820	658,821	2,072,370	6	10	3	19	13	32
1962	129,268	221,536	68,902	419,706	287,560	707,266	2,228,152	6	10	3	19	13	32
1963	146,656	226,191	69,844	442,691	298,956	741,647	2,377,044	6	9	3	18	13	31
1964	156,577	233,252	71,698	461,527	317,450	778,977	2,485,311	6	9	3	18	13	31
1965	161,987	233,872	77,565	473,424	338,609	812,033	2,641,140	6	9	3	18	13	31
1966	182,530	221,826	90,232	494,588	378,162	872,750	2,993,568	6	7	3	16	13	29
1967	183,677	236,833	95,510	516,020	420,450	936,470	3,211,912	6	7	3	16	13	29
1968	187,479	249,523	97,073	534,075	457,726	991,801	3,367,111	6	7	3	16	14	30
1969	191,999	257,348	105,093	554,440	483,009	1,037,449	3,429,129	6	7	3	16	14	30

[1] Cost of fuel and lubricants not reported separately until 1951.

Source: Dominion Bureau of Statistics, *Handbook of Agricultural Statistics,* Part II, 1926-65, Cat. No. 21-511, DBS, *Farm Net Income,* 1969, Cat. No. 21-202, Table 5.

TABLE A.10–MACHINERY OPERATING AND DEPRECIATION EXPENSES, AND MACHINERY OPERATING AND DEPRECIATION EXPENSES AS A PERCENTAGE OF TOTAL FARM OPERATING AND DEPRECIATION EXPENSES, CANADA AND PROVINCES (EXCLUDING NEWFOUNDLAND), 1927, 1947, 1957, 1967

		Machinery Operating Expenses		Machinery Depreciation Expenses		Total Machinery Operating and Machinery Depreciation Expenses		Total Farm Operating and Depreciation Expenses
		($'000)	(Per cent)[1]	($'000)	(Per cent)[1]	($'000)	(Per cent)[1]	($'000)
Canada	1927	76,141	12	60,642	10	136,783	22	611,895
	1947	179,662	17	94,089	9	273,751	26	1,065,874
	1957	364,202	21	238,041	14	602,243	35	1,736,230
	1967	516,020	16	420,450	13	936,470	29	3,211,912
Prince Edward Island	1927	397	8	505	10	902	18	5,138
	1947	1,055	9	717	6	1,772	15	11,789
	1957	2,608	14	1,946	11	4,554	25	18,294
	1967	4,763	15	3,417	10	8,180	25	32,220
Nova Scotia	1927	1,194	9	688	5	1,882	14	13,134
	1947	2,410	10	1,172	5	3,582	15	23,906
	1957	4,582	15	2,475	8	7,057	23	29,969
	1967	5,673	13	3,144	7	8,817	20	44,855
New Brunswick	1927	1,220	10	885	7	2,105	17	12,272
	1947	2,396	10	1,225	5	3,621	15	23,434
	1957	5,586	18	2,643	8	8,229	26	31,336
	1967	6,396	15	3,458	8	9,854	23	42,951
Quebec	1927	5,514	7	6,685	9	12,199	16	75,650
	1947	12,395	7	9,485	6	21,880	13	169,179
	1957	36,582	13	22,146	8	58,728	21	272,651
	1967	59,977	12	37,113	7	97,090	19	503,713

Ontario	1927	19,105	11	11,225	6	30,330	17	175,453
	1947	39,056	12	18,018	5	57,074	17	330,405
	1957	81,132	14	48,728	9	129,860	23	574,729
	1967	118,735	11	87,807	8	206,542	19	1,058,592
Manitoba	1927	9,032	16	7,374	13	16,406	29	55,563
	1947	23,404	25	11,912	13	35,316	38	92,148
	1957	41,682	30	28,959	21	70,641	51	138,395
	1967	57,457	21	47,762	18	105,219	39	271,453
Saskatchewan	1927	25,784	16	20,654	13	46,438	29	161,173
	1947	56,265	27	28,355	14	84,620	41	204,408
	1957	99,277	31	71,320	22	170,597	53	319,878
	1967	127,741	22	127,634	22	255,375	44	574,798
Alberta	1927	12,127	13	11,829	12	23,956	25	96,269
	1947	38,669	23	20,860	13	59,529	36	163,403
	1957	83,040	30	53,620	19	136,660	49	275,981
	1967	119,857	22	98,815	18	218,672	40	543,332
British Columbia	1927	1,768	9	797	4	2,565	13	19,243
	1947	4,012	8	2,345	5	6,357	13	47,202
	1957	9,713	13	6,204	8	15,917	21	74,997
	1967	15,421	11	11,300	8	26,721	19	139,998

[1] Expressed as a percentage of Total Farm Operating and Depreciation Expenses.

Source: Dominion Bureau of Statistics, *Handbook of Agricultural Statistics,* Part II, Farm Income – 1926-1965, Cat. No. 21-511 (Ottawa: Queen's Printer, June 1967),
DBS, *Farm Net Income, 1969,* Cat. No. 21-202 (Ottawa: Queen's Printer, June 1970).

TABLE A.11–SALES OF SELECTED FARM MACHINES AND REPAIR PARTS, CANADA, 1936-69

(Dollars in millions and as percentages of total sales)

	Tractors		Combines		Haying Machinery[1]		Tillage Machinery[2]		Plows[3]		Total Sales of Machines		Sales of Repair Parts		
	$	As Percentage of Total Sales of Machines	$	As Percentage of Total Sales of Machines	$	As Percentage of Total Sales of Machines	$	As Percentage of Total Sales of Machines	$	As Percentage of Total Sales of Machines	$	As Percentage of Total Sales of Machines and Repair Parts	$	As Percentage of Total Sales of Machines and Repair Parts	Total Sales of Machines and Repair Parts $
1936	6.2	32.1	0.3	1.6	1.0	5.2	3.5	18.1	2.3	11.9	19.3	84.6	3.5	15.4	22.8
1937	12.5	40.6	0.4	1.3	1.3	4.2	4.7	15.3	3.0	9.7	30.8	84.6	5.6	15.4	36.4
1938	15.3	42.3	1.6	4.4	1.4	3.9	4.6	12.7	2.6	7.2	36.2	84.6	6.6	15.4	42.8
1939	14.8	43.4	2.9	8.5	1.1	3.2	4.3	12.6	2.6	7.6	34.1	84.6	6.2	15.4	40.3
1940	20.6	43.2	6.1	12.8	1.5	3.1	6.4	13.4	4.1	8.6	47.7	84.6	8.7	15.4	56.4
1941	22.1	42.4	4.7	9.0	1.8	3.5	7.4	14.2	4.7	9.0	52.1	84.6	9.5	15.4	61.6
1942	18.9	37.4	5.8	11.5	1.8	3.6	6.5	12.9	3.9	7.7	50.5	84.7	9.2	15.4	59.6
1943	8.4	28.2	3.3	11.1	1.1	3.7	5.1	17.1	3.2	10.7	29.8	66.8	14.8	33.2	44.6
1944	21.0	38.3	7.6	13.9	1.6	2.9	2.1	3.8	3.4	6.2	54.8	76.2	17.1	23.8	71.9
1945	19.7	30.6	9.9	15.4	2.4	3.7	3.1	4.8	4.2	6.5	64.3	77.5	18.7	22.5	83.0
1946	22.9	28.0	10.4	12.7	3.7	4.5	4.6	5.6	5.5	6.7	81.7	79.7	20.8	20.3	102.5
1947	39.3	32.1	17.0	13.9	5.7	4.7	6.3	5.1	8.2	6.7	122.4	84.0	23.3	16.0	145.7
1948	59.2	34.7	31.4	18.4	9.4	5.5	9.3	5.4	12.0	7.0	170.7	86.3	27.0	13.7	197.7
1949	94.7	43.6	29.7	13.7	10.6	4.9	12.2	5.6	17.9	8.2	217.1	88.5	28.1	11.5	245.2
1950	96.4	44.2	34.6	15.9	10.6	4.9	13.2	6.0	15.2	7.0	218.2	88.0	29.9	12.1	248.0

1951	90.5	38.4	46.2[4]	19.6	14.8	6.3	12.5	5.3	15.4	6.5	235.6	89.1	28.8	10.9	264.4
1952	87.9	35.1	61.8	24.7	17.2	6.9	10.1	4.0	18.2	7.3	250.3	88.9	31.2	11.1	281.5
1953	82.5	34.6	57.9	24.3	20.8	8.7	10.7	4.5	16.9	7.1	238.1	88.2	31.8	11.8	269.9
1954	53.4	36.4	19.4	13.2	17.7	12.1	7.6	5.2	10.2	7.0	146.7	84.3	27.3	15.7	174.0
1955	57.1	37.3	20.7	13.5	19.8	12.9	7.0	4.6	8.2	5.4	153.1	84.3	28.5	15.7	181.6
1956	61.8	36.2	25.3	14.8	27.2	15.9	7.1	4.2	8.0	4.7	170.8	84.3	31.8	15.7	202.6
1957	54.9	36.6	16.9	11.3	23.6	15.7	7.8	5.2	8.9	5.9	149.9	81.6	33.8	18.4	183.7
1958	61.2	35.6	21.5	12.5	26.3	15.3	9.7	5.6	9.8	5.7	172.0	83.5	34.0	16.5	206.0
1959	76.6	36.1	33.4	15.7	30.7	14.5	11.9	5.6	11.2	5.3	212.2	84.5	38.9	15.5	251.1
1960	78.7	36.2	35.5	16.3	30.5	14.0	12.6	5.8	11.6	5.3	217.5	84.0	41.3	16.0	258.8
1961	73.4	36.4	26.3	13.0	29.3	14.5	12.9	6.4	11.5	5.7	201.8	83.6	39.6	16.4	241.4
1962	78.3	32.8	43.3	18.1	32.2	13.5	15.4	6.4	11.2	4.7	238.8	84.5	43.9	15.5	282.7
1963	94.8	32.9	58.2	20.2	31.4	10.9	18.0	6.3	12.9	4.5	287.8	85.3	49.7	14.7	337.5
1964	111.1	34.0	60.2	18.4	30.9	9.5	21.1	6.5	15.9	4.9	326.9	86.0	53.2	14.0	380.1
1965	119.7	32.2	81.5	21.9	30.0	8.1	23.5	6.3	17.2	4.6	371.3	87.0	55.6	13.0	426.9
1966	145.7	34.9	73.7	17.7	29.8	7.1	28.8	6.9	19.7	4.7	416.9	87.1	62.0	12.9	478.9
1967	148.0	34.2	65.5	15.2	29.0	6.7	33.8	7.8	20.9	4.8	432.3	87.5	62.0	12.5	494.3
1968	116.7	30.9	56.3	14.9	26.4	7.0	28.7	7.6	16.0	4.2	378.1	85.5	64.0	14.5	442.1
1969	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	340.3	83.7	66.3	16.3	406.6

[1] Haying machinery includes: mowers, rakes, conditioners, balers, etc.
[2] Tillage machinery includes: harrows, rotary hoes, pulverizers, cultivators, rod weeders, etc.; until 1943 included plows as well.
[3] Plows include: moldboard, disk plows, diskers, rotary tillers, etc.; until 1943 plows were considered part of tillage machinery.
[4] Does not include category of over 6 ft. PTO.

Source: Dominion Bureau of Statistics, *Farm Implement and Equipment Sales*, Cat. No. 63-203 (Ottawa: Queen's Printer, 1936-69).

TABLE A.12–TOTAL AND IMPROVED ACREAGE, ALL FARMS AND PER FARM, CANADA AND PROVINCES, CENSUS YEARS 1921-66

		Canada[1]	Nfld.[2]	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Total acreage of all	1921	140.9[3]	n.a.	1.2	4.7	4.3	17.3	22.6	14.6[3]	44.0[3]	29.3[3]	2.9
census-farms	1931	163.1	n.a.	1.2	4.3	4.2	17.3	22.8	15.1	55.7	39.0	3.5
(Millions of acres	1941	173.6	n.a.	1.2	3.8	4.0	18.1	22.4	16.9	60.0	43.3	4.0
except for Nfld. shown	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	16.7	59.4	41.5	n.a.
in actual acres)	1951	174.0	85,040	1.1	3.2	3.5	16.8	20.9	17.7	61.7	44.5	4.7
	1956	173.9	71,814	1.1	2.8	3.0	15.9	19.9	17.9	62.8	46.0	4.5
	1961	172.6	54,561	1.0	2.2	2.2	14.2	18.6	18.2	64.4	47.2	4.5
	1966	174.1	49,513	0.9	1.9	1.8	12.9	17.8	19.1	65.4	49.0	5.3
Average acreage per	1921	198	n.a.	89	100	116	125	114	274	369	353	130
census-farm[5]	1931	224	n.a.	93	109	122	127	119	279	408	400	136
	1941	237	n.a.	96	116	124	117	126	291	432	434	153
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	306	473	463	n.a.
	1951	279	23	108	135	131	125	139	338	550	527	178
	1956	302	30	113	132	135	130	141	364	607	578	183
	1961	359	31	131	178	187	148	153	420	686	645	226
	1966	404	29	146	192	208	160	162	480	763	706	277
Improved acreage of all	1921	70.8	n.a.	0.8	1.0	1.4	9.1	13.2	8.1	25.0	12.0	0.5
census-farms	1931	85.7	n.a.	0.8	0.8	1.3	9.0	13.3	8.5	33.5	17.7	0.7
(Millions of acres	1941	91.6	n.a.	0.7	0.8	1.2	9.1	13.4	9.8	35.6	20.1	0.9
except for Nfld. shown	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	9.8	35.6	20.0	n.a.
in actual acres)	1951	96.9	28,981	0.6	0.7	1.0	8.8	12.7	10.8	38.8	22.3	1.1
	1956	100.3	24,234	0.6	0.6	1.0	8.6	12.6	11.5	40.5	23.7	1.2
	1961	103.4	20,455	0.6	0.5	0.7	7.9	12.0	12.0	43.1	25.3	1.3
	1966	108.2	20,566	0.6	0.5	0.6	7.6	12.0	12.4	45.5	27.3	1.6

Average improved acreage per census-farm[5]	1921	100	n.a	56	21	37	66	66	151	210	142	25
	1931	118	n.a.	60	21	39	66	69	157	246	182	27
	1941	125	n.a.	60	25	39	59	75	169	256	202	33
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	179	283	223	n.a.
	1951	155	8	64	28	38	66	85	205	346	264	43
	1956	174	10	68	30	43	70	89	233	392	299	47
	1961	215	12	79	40	62	82	99	276	459	345	65
	1966	251	12	90	50	73	95	109	313	531	393	85

[1] Contains information for Yukon and Northwest Territories for 1951 and subsequent years.
[2] Data not available prior to union of Newfoundland with Canada in 1949.
[3] Farms on Indian Reserves in the Prairie Provinces were not included.
[4] Only Prairie Provinces enumerated in 1946 Census.
[5] See Table A.15 for number of census-farms.

Source: Dominion Bureau of Statistics, *1966 Census of Canada, Agriculture* (Ottawa: Queen's Printer, 1968), Tables 2 and 14.

TABLE A. 13–TOTAL VALUE OF INVESTMENT IN FARM MACHINERY IN MILLIONS OF DOLLARS; NUMBER OF HORSES, MOTOR TRUCKS, TRACTORS AND GRAIN COMBINES ON FARMS, CANADA AND PROVINCES, CENSUS YEARS 1921-66

		Canada[1]	Nfld.[2]	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Total value of investment in farm machinery on census-farms ($'000,000)	1921	665.2[3,4]	n.a.	6.9[4]	10.1[4]	13.5[4]	111.9[4]	170.0[4]	67.8[3,4]	176.7[3,4]	98.8[3,4]	9.4[4]
	1931	650.7	n.a.	8.1	10.6	13.3	97.3	151.9	54.8	185.5	116.3	12.9
	1941	596.0	n.a.	5.8	11.0	10.8	85.2	150.4	58.9	142.8	116.1	15.1
	1946[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	94.4	223.5	163.3	n.a.
	1951	1,933.3	1.4	16.3	25.2	27.0	211.9	445.3	231.8	525.6	390.0	58.8
	1956[6]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1961	2,568.6	2.9	26.9	30.3	31.7	301.3	579.3	272.0	686.8	550.9	86.5
	1966	3,522.4	3.5	35.7	34.4	36.8	374.0	758.4	380.4	1,020.6	785.0	123.5
Number of horses on census-farms ('000)	1921	3,451.8[3]	n.a.	32.0	54.4	62.4	332.5	669.0	355.7[3]	1,077.9[3]	806.2[3]	61.4
	1931	3,113.9	n.a.	30.0	43.1	51.2	301.4	577.3	324.7	997.4	731.7	57.2
	1941	2,788.8	n.a.	28.0	36.2	45.2	332.7	532.0	301.8	800.7	649.2	63.0
	1946[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	215.1	570.5	469.2	n.a.
	1951	1,306.6	2.9	21.3	26.0	31.0	232.9	260.6	130.9	303.9	261.1	36.1
	1956	784.0	1.7	14.6	17.9	19.3	163.6	139.7	75.1	170.8	154.7	26.7
	1961	512.0	1.2	7.9	8.9	9.3	97.4	88.9	50.8	110.3	113.2	23.9
	1966	387.3	1.1	5.0	5.7	6.1	62.1	75.4	37.0	74.7	93.7	26.5
Number of tractors on census-farms	1921	47,455[3]	n.a.	49	164	104	968	7,161	10,027[3]	19,243[3]	9,215[3]	524
	1931	105,360	n.a.	176	424	289	2,417	18,993	14,366	43,308	23,985	1,402
	1941	159,752	n.a.	577	1,386	1,140	5,869	35,460	22,050	54,129	36,445	2,696
	1946[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	30,802	71,596	48,763	n.a.
	1951	399,686	126	2,776	4,307	5,221	31,971	105,204	50.984	106,664	79,282	13,148
	1956	499,811	296	4,840	6,537	7,646	54,322	136,062	59,265	121,388	94,156	15,282
	1961	549,789	462	5,713	7,074	8,102	70,697	150,046	61,463	126,613	102,624	16,974
	1966	598,483	519	6,341	7,252	7,989	81,674	162,303	65,552	134,908	112,245	19,676

Number of motor trucks on census-farms	1921[6]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1931	48,401	n.a.	369	1,704	1,126	5,152	14,586	3,260	10,938	7,319	3,947
	1941	77,480	n.a.	494	2,697	1,861	6,703	17,537	7,566	21,285	14,512	4,825
	1946[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	9,970	27,756	18,451	n.a.
	1951	196,122	507	1,679	5,687	4,786	19,167	41,486	21,163	52,626	39,723	9,291
	1956	277,183	735	3,247	7,200	5,614	28,758	58,041	28,556	74,498	58,749	11,758
	1961	302,012	715	3,253	5,965	4,657	26,597	62,812	31,806	82,669	71,508	12,004
	1966	344,836	764	3,306	5,393	4,404	24,499	67,622	36,689	102,470	85,559	14,116
Number of combines on census-farms	1921[6]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1931	8,917	n.a.	nil	nil	nil	nil	nil	355	6,019	2,523	20
	1941	19,013	n.a.	4	2	15	55	796	1,714	11,202	5,165	60
	1946[5]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5,724	22,498	10,648	n.a.
	1951	90,500	nil	18	16	211	420	10,031	15,268	42,997	20,851	687
	1956	136,927	nil	238	88	598	1,481	16,644	21,425	61,861	33,531	1,060
	1961	155,611	2	644	154	770	3,046	22,387	23,662	65,084	38,530	1,331
	1966	170,182	nil	1,020	252	965	6,108	25,372	24,815	67,144	42,838	1,667

[1] Contains information for Yukon and Northwest Territories for 1951 and subsequent years.
[2] Data not available prior to union of Newfoundland with Canada in 1949.
[3] Farms on Indian Reserves were not included in the Prairie Provinces and in the totals for Canada in 1921.
[4] Does not include automobiles.
[5] Only Prairie Provinces enumerated.
[6] Not enumerated.

TABLE A.14 – REAL ESTATE VALUES IN DOLLARS PER ACRE, CANADA AND MAJOR REGIONS, SELECTED YEARS, 1910-69

	Canada	Quebec	Ontario	Prairies[1]
1910	33	43	48	24
1920	48	70	70	33
1929	37	55	60	26
1930	32	48	52	23
1935	24	41	42	17
1939	25	44	46	16
1940	24	44	46	16
1945	30	57	57	19
1946	32	59	59	21
1947	35	61	64	23
1948	39	63	68	28
1949	40	59	71	29
1950	43	66	75	31
1951	47	74	90	33
1952	48	76	92	34
1953	51	77	98	36
1954	50	81	101	36
1955	52	82	107	37
1956	55	86	111	34
1957	56	86	115	38
1958	58	89	123	40
1959	60	92	133	40
1960	62	95	132	43
1961	65	98	141	45
1962	67	97	147	47
1963	72	100	150	53
1964	80	104	163	61
1965	90	111	175	71
1966	100	119	195	76
1967	111	123	224	89
1968	120	132	258	94
1969	122	–	–	–

[1] Weighted average, using acreages of farmland in provinces as weights.

Source: Dominion Bureau of Statistics, special data from Agriculture Division, Finance Section; and *Census of Canada, Agriculture,* various years.

TABLE A.15 – POPULATION ON CENSUS-FARMS, NUMBER OF CENSUS-FARMS, AND POPULATION PER CENSUS-FARM, CANADA AND PROVINCES, 1921-66

		Canada[1]	Nfld.[2]	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Population on census-farms ('000)	1921[3]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1931	3,289	n.a.	55	178	180	777	801	256	564	375	102
	1941	3,152	n.a.	51	144	164	839	704	250	515	384	102
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	225	435	336	n.a.
	1951	2,912	20	47	115	150	793	703	219	399	345	120
	1956	2,747	13	43	99	129	765	683	207	362	332	113
	1961	2,128	11	35	58	63	585	524	173	306	288	85
	1966	1,960	9	31	46	52	508	498	162	281	282	91
Percentage of total population living on census-farms	1921[3]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1931	31.7	n.a.	63.0	34.6	44.1	27.0	23.3	36.6	61.2	51.3	14.7
	1941	27.4	n.a.	53.7	24.9	35.8	25.2	18.6	34.2	57.4	48.2	12.5
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	30.9	52.2	41.8	n.a.
	1951	20.8	5.5	47.6	18.0	29.1	19.5	15.3	28.2	48.0	36.7	10.3
	1956	17.1	3.1	43.6	14.2	23.3	16.5	12.6	24.3	41.1	29.6	8.1
	1961	11.7	2.4	33.2	7.9	10.6	11.1	8.4	18.8	33.0	21.6	5.2
	1966	9.8	1.8	28.6	6.1	8.4	8.8	7.2	16.8	29.4	19.2	4.9
Number of census-farms ('000)	1921	711.1[5]	n.a.	13.7	47.4	36.7	137.6	198.1	53.3[5]	119.5[5]	83.0[5]	22.0
	1931	728.6	n.a.	12.9	39.4	34.0	136.0	192.2	54.2	136.5	97.4	26.1
	1941	732.8	n.a.	12.2	33.0	31.9	154.7	178.2	58.0	138.7	99.7	26.4
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	54.4	125.6	89.5	n.a.
	1951	623.1	3.6	10.1	23.5	26.4	134.3	149.9	52.4	112.0	84.3	26.4
	1956	575.0	2.4	9.4	21.1	22.1	122.6	140.6	49.2	103.4	79.4	24.7
	1961	480.9	1.8	7.3	12.5	11.8	95.8	121.3	43.3	93.9	73.2	19.9
	1966	430.5	1.7	6.4	9.6	8.7	80.3	109.9	39.7	85.7	69.4	19.1
Number of persons per census-farm	1921[3]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	1931	4.5	n.a.	4.3	4.5	5.3	5.7	4.2	4.7	4.1	3.9	3.9
	1941	4.3	n.a.	4.2	4.4	5.1	5.4	4.0	4.3	3.7	3.9	3.9
	1946[4]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4.1	3.5	3.8	n.a.
	1951	4.7	5.6	4.7	4.9	5.7	5.9	4.7	4.2	3.6	4.1	4.5
	1956	4.8	5.4	4.6	4.7	5.8	6.2	4.9	4.2	3.5	4.2	4.6
	1961	4.4	6.1	4.8	4.6	5.3	6.1	4.3	4.0	3.3	3.9	4.3
	1966	4.6	5.3	4.8	4.8	6.0	6.3	4.5	4.1	3.3	4.1	4.8

[1] Contains information for Yukon and Northwest Territories for 1951 and subsequent years.
[2] Data not available prior to union of Newfoundland with Canada in 1949.
[3] Farm population not available prior to 1931 Census.
[4] Only Prairie Provinces enumerated in 1946 Census, in relation to data on farm population.
[5] Farms on Indian Reserves not included in Prairie Provinces and in totals for Canada in 1921.

TABLE A.16–DERIVATION OF DETAILED PRODUCTIVITY INDEXES FOR SELECTED AGRICULTURAL INPUTS

	Adjusted Gross Value of Agricultural Production			
	Adjusted Value of Agricultural Output[1]	Index of Prices Received for Farm Products[2] (1935-39=100)	Adjusted Value of Agricultural Output Deflated by Farm Prices Index (1) ÷ (2)	Index of Adjusted Agricultural Output (1951=100)
	(1) ($ Million)	(2)	(3) ($ Million)	(4)
1926	1,095.3	144.4	758.5	71.6
1927	1,139.1	138.6	821.9	77.5
1928	1,167.7	136.3	856.7	80.8
1929	932.6	140.8	662.4	62.5
1930	855.7	119.5	716.1	67.5
1931	549.3	78.9	696.2	65.7
1932	503.6	65.5	768.8	72.5
1933	471.7	69.3	680.7	64.2
1934	580.6	83.5	695.3	65.6
1935	625.1	88.0	710.3	67.0
1936	637.7	96.9	658.1	62.1
1937	721.0	119.7	602.3	56.8
1938	782.8	105.0	745.5	70.4
1939	864.9	91.8	942.2	88.9
1940	934.6	96.8	965.5	91.1
1941	946.6	110.2	858.9	81.0
1942	1,575.8	133.1	1,183.9	111.7
1943	1,391.4	157.8	881.7	83.2
1944	1,772.8	172.4	1,028.3	97.0
1945	1,575.2	185.7	848.2	80.0
1946	1,894.3	204.1	928.1	87.5
1947	1,995.0	215.8	924.5	87.3
1948	2,380.5	255.8	930.6	87.8
1949	2,229.8	255.4	873.0	82.4
1950	2,523.9	260.8	967.7	91.3
1951	3,145.4	296.8	1,059.8	100.0
1952	3,275.9	274.4	1,193.9	112.6
1953	2,890.1	250.4	1,154.2	108.9
1954	2,256.2	236.8	952.8	81.9
1955	2,590.7	232.7	1,113.3	105.0
1956	2,818.4	234.6	1,201.4	113.3
1957	2,460.8	234.2	1,050.7	99.2
1958	2,769.4	245.5	1,128.1	106.4
1959	2,736.8	247.4	1,106.2	104.3
1960	2,914.2	250.0	1,165.7	110.0
1961	2,605.0	261.2	997.3	94.0
1962	3,426.5	272.0	1,259.7	118.9
1963	3,735.7	268.4	1,391.8	131.3
1964	3,447.2	265.8	1,296.9	122.4
1965	3,850.6	282.2	1,365.0	128.8
1966	4,642.6	307.0	1,512.2	142.6
1967	4,071.7	304.7	1,336.3	126.0
1968	4,293.5	298.0	1,440.8	135.9

[1] Dominion Bureau of Statistics, Agricultural Division, unpublished series.

[2] Wholesale Price Index of Canadian Farm Products 1926-34 taken from M. C. Urquhart, K. A. H. Buckley (eds.), *Historical Statistics of Canada* (Series J 77). Index of Farm Prices of Agricultural Production for years 1935-50 from *Historical Statistics of Canada* (Series L 88); for 1950-69 from Economics Branch, Canada Department of Agriculture, *Canadian Farm Economics*, various years.

TABLE A.16–DERIVATION OF DETAILED PRODUCTIVITY INDEXES FOR SELECTED AGRICULTURAL INPUTS *(Continued)*

	Output Related to Capital Employed				
	Total Capital on Farms[3]	Deflator for Capital (Table A.16-1, Col. 6)	Total Capital on Farms (5) ÷ (6)	Output per Constant $ Million Total of Capital (3) ÷ (7)	Index of Output per Constant $ Million Total of Capital (1951=100)
	(5) (Current $ Million)	(6)	(7) (Constant $ Million)	(8)	(9)
1926	6,151	142.2	4,326	.18	81.8
1927	6,230	145.4	4,285	.19	86.3
1928	6,300	145.4	4,333	.20	90.9
1929	6,313	142.2	4,440	.15	68.2
1930	5,849	125.6	4,657	.15	68.2
1931	5,256	112.1	4,689	.15	68.2
1932	4,733	98.7	4,795	.16	72.7
1933	4,443	98.3	4,520	.15	68.2
1934	4,464	95.6	4,669	.15	68.2
1935	4,523	99.0	4,569	.16	72.7
1936	4,390	99.5	4,412	.15	68.2
1937	4,384	99.4	4,410	.14	63.6
1938	4,214	100.9	4,176	.18	81.8
1939	4,299	104.1	4,130	.23	104.5
1940	4,214	101.2	4,164	.23	104.5
1941	4,247	105.2	4,037	.21	95.5
1942	4,681	109.6	4,271	.28	127.3
1943	5,275	116.8	4,516	.20	90.9
1944	5,490	123.6	4,442	.23	104.5
1945	5,580	122.9	4,540	.19	86.3
1946	5,878	130.2	4,515	.21	95.5
1947	6,390	141.7	4,509	.21	95.5
1948	7,105	158.1	4,494	.21	95.5
1949	7,503	164.9	4,550	.19	86.3
1950	8,171	176.2	4,637	.21	95.5
1951	9,451	193.9	4,874	.22	100.0
1952	9,536	199.0	4,792	.25	113.6
1953	10,110	209.2	4,833	.23	104.5
1954	9,959	206.1	4,832	.20	90.9
1955	10,313	212.9	4,844	.23	104.5
1956	10,539	225.0	4,684	.26	118.2
1957	10,842	231.2	4,689	.22	100.0
1958	11,742	240.5	4,882	.23	104.5
1959	12,308	249.5	4,933	.22	100.0
1960	12,680	257.2	4,930	.24	109.1
1961	13,159	268.7	4,897	.20	90.9
1962	13,670	276.8	4,939	.26	118.2
1963	14,509	294.3	4,930	.28	127.3
1964	15,744	321.9	4,891	.27	122.7
1965	17,218	355.9	4,838	.28	127.3
1966	19,063	390.5	4,882	.31	140.9
1967	20,952	428.6	4,888	.27	122.7
1968	22,378	460.5	4,860	.30	136.4

[3] M. C. Urquhart, K. A. H. Buckley (eds.), *ibid.* (Series L 18) and DBS, *Quarterly Bulletin of Agricultural Statistics,* April-June 1966 and April-June 1969, Cat. No. 21-003. Newfoundland not included in totals.

TABLE A.16 DERIVATION OF DETAILED PRODUCTIVITY INDEXES FOR SELECTED AGRICULTURAL INPUTS *(Continued)*

	Output Related to Machinery Employed				
	Value of Machinery on Farms[4]	Deflator for Machinery (Table A.16-1, Col. 4)	Value of Machinery on Farms	Output per Constant $ Million Value of Machinery (3) ÷ (12)	Index of Output per Constant $ Million Value of Machinery (1951=100)
	(10) (Current $ Million)	(11)	(12) (Constant $ Million)	(13)	(14)
1926	665	97.6	681	1.11	107.8
1927	665	97.5	682	1.21	117.5
1928	665	97.6	681	1.26	122.3
1929	665	97.5	682	.97	94.2
1930	651	97.0	671	1.07	103.9
1931	651	94.9	686	1.01	98.1
1932	651	94.1	692	1.11	107.8
1933	574	92.1	623	1.09	105.8
1934	539	94.6	570	1.22	118.4
1935	534	95.5	559	1.27	123.3
1936	524	97.8	536	1.23	119.4
1937	527	97.2	542	1.11	107.8
1938	544	104.1	523	1.43	138.8
1939	547	103.6	528	1.78	172.8
1940	568	105.8	537	1.80	174.8
1941	596	109.1	546	1.57	152.4
1942	660	114.4	577	2.05	199.0
1943	722	117.1	617	1.43	138.8
1944	758	118.2	641	1.60	155.3
1945	827	115.1	719	1.18	114.6
1946	905	118.8	762	1.22	118.4
1947	1,027	126.3	813	1.14	110.7
1948	1,195	141.6	844	1.10	106.8
1949	1,416	158.3	894	.98	95.1
1950	1,681	165.1	1,018	.95	92.2
1951	1,932	186.8	1,034	1.03	100.0
1952	2,077	195.4	1,063	1.12	108.7
1953	2,258	196.7	1,148	1.01	98.1
1954	2,353	197.9	1,189	.80	77.7
1955	2,284	198.8	1,149	.97	94.2
1956	2,263	209.4	1,081	1.11	107.8
1957	2,371	223.8	1,059	.99	96.1
1958	2,441	236.1	1,034	1.09	105.8
1959	2,510	247.8	1,013	1.09	105.8
1960	2,575	253.5	1,016	1.15	111.7
1961	2,566	260.7	984	1.01	98.1
1962	2,660	268.1	992	1.27	123.3
1963	2,811	272.9	1,030	1.35	131.1
1964	3,016	279.6	1,079	1.20	116.5
1965	3,263	284.9	1,145	1.19	115.5
1966	3,549	293.1	1,211	1.25	121.4
1967	3,829	302.2	1,267	1.05	101.9
1968	4,027	313.7	1,284	1.12	108.7

[4] M. C. Urquhart, K. A. H. Buckley (eds.), *ibid.* (Series L 16) and DBS, *Quarterly Bulletin of Agricultural Statistics*, April-June 1966 and April-June 1969, Cat. No. 21-003. Newfoundland not included in totals.

TABLE A.16–DERIVATION OF DETAILED PRODUCTIVITY INDEXES FOR SELECTED AGRICULTURAL INPUTS *(Continued)*

	Output per Man		
	Number of Persons Employed in Agriculture[5]	Output per Man (3) ÷ (15)	Index of Output per Man (1951=100)
	(15) ('000)	(16)	(17)
1926	1,251	607	53.8
1927	1,284	640	56.7
1928	1,305	657	58.2
1929	1,307	507	44.9
1930	1,238	578	51.2
1931	1,216	572	50.7
1932	1,237	622	55.1
1933	1,257	541	47.9
1934	1,277	544	48.2
1935	1,298	547	48.4
1936	1,319	499	44.2
1937	1,339	450	39.9
1938	1,359	549	48.6
1939	1,379	683	60.5
1940	1,344	719	63.7
1941	1,224	702	62.2
1942	1,139	1,040	92.1
1943	1,118	789	69.9
1944	1,136	905	80.2
1945	1,144	741	65.6
1946	1,186	782	69.3
1947	1,122	824	73.0
1948	1,096	849	75.2
1949	1,077	811	71.8
1950	1,018	951	84.2
1951	939	1,129	100.0
1952	891	1,340	118.7
1953	858	1,345	119.1
1954	878	1,085	96.1
1955	819	1,359	120.4
1956	777	1,546	136.9
1957	748	1,405	124.4
1958	718	1,571	139.1
1959	700	1,580	139.9
1960	683	1,707	151.1
1961	681	1,464	129.7
1962	660	1,909	169.1
1963	649	2,145	190.0
1964	630	2,059	182.4
1965	594	2,298	203.5
1966	544	2,779	246.1
1967	559	2,390	211.7
1968	546	2,639	233.7

[5] M. C. Urquhart, K. A. H. Buckley (eds.), *ibid.* (Series C 53) and DBS, Special Surveys Division, The Labour Force, Cat. No. 71-001, Supplement. Newfoundland included beginning in 1950.

TABLE A.16 DERIVATION OF DETAILED PRODUCTIVITY INDEXES FOR SELECTED AGRICULTURAL INPUTS *(Concluded)*

	Output per Acre		
	Number of Acres of Improved Land[6]	Output per Acre (3) ÷ (18)	Index of Output per Acre (1951=100)
	(18) ('000)	(19)	(20)
1926			
1927			
1928			
1929			
1930			
1931	85.7	81.2	74.2
1932			
1933			
1934			
1935			
1936			
1937			
1938			
1939			
1940			
1941	91.6	93.8	85.7
1942			
1943			
1944			
1945			
1946			
1947			
1948			
1949			
1950			
1951	96.9	109.4	100.0
1952			
1953			
1954			
1955			
1956	100.3	119.8	109.5
1957			
1958			
1959			
1960			
1961	103.4	96.5	88.2
1962			
1963			
1964			
1965			
1966	108.2	139.8	127.8
1967			
1968			

[6] DBS, *1966 Census of Canada*, Table 2.

TABLE A.16-1–DERIVATION OF DEFLATOR FOR CAPITAL, USED IN TABLE A.16

	Average Value of Farmland per Acre[1]	Land Value Index Derived from (1) (1935-39=100)	Land Value Index, Weighted by Proportion of Capital Represented by Land[2]	Machinery Cost Index (1935-39=100)[3]	Machinery Cost Index, Weighted by Proportion of Capital Represented by Machinery[2]	Deflator for Capital (3) + (5)
	(1)	(2)	(3)	(4)	(5)	(6)
1926	37	154.2	121.5	97.6	20.7	142.2
1927	38	158.3	124.7	97.5	20.7	145.4
1928	38	158.3	124.7	97.6	20.7	145.4
1929	37	154.2	121.5	97.5	20.7	142.2
1930	32	133.3	105.0	97.0	20.6	125.6
1931	28	116.7	92.0	94.9	20.1	112.1
1932	24	100.0	78.8	94.1	19.9	98.7
1933	24	100.0	78.8	92.1	19.5	98.3
1934	23	95.8	75.5	94.6	20.1	95.6
1935	24	100.0	78.8	97.8	20.7	99.0
1936	24	100.0	78.8	97.8	20.7	99.5
1937	24	100.0	78.8	97.2	20.6	99.4
1938	24	100.0	78.8	104.1	22.1	100.9
1939	25	104.2	82.1	103.6	22.0	104.1
1940	24	100.0	78.8	105.8	22.4	101.2
1941	25	104.2	82.1	109.1	23.1	105.2
1942	26	108.3	85.3	114.4	24.3	109.6
1943	28	116.7	92.0	117.1	24.8	116.8
1944	30	112.0	98.5	118.2	25.1	123.6
1945	30	125.0	98.5	115.1	24.4	122.9
1946	32	133.3	105.0	118.8	25.2	130.2
1947	35	145.8	114.9	126.3	26.8	141.7
1948	39	162.5	128.1	141.6	30.0	158.1
1949	40	166.6	131.3	158.3	33.6	164.9
1950	43	179.2	141.2	165.1	35.0	176.2
1951	47	195.8	154.3	186.8	39.6	193.9
1952	48	200.0	157.6	195.4	41.4	199.0
1953	51	212.5	167.5	196.7	41.7	209.2
1954	50	208.3	164.1	197.9	42.0	206.1
1955	52	216.7	170.8	198.8	42.1	212.9
1956	55	229.2	180.6	209.4	44.4	225.0
1957	56	233.3	183.8	223.8	47.4	231.2
1958	58	241.7	190.5	236.1	50.0	240.5
1959	60	250.0	197.0	247.8	52.5	249.5
1960	62	258.3	203.5	253.5	53.7	257.2
1961	65	270.8	213.4	260.7	55.3	268.7
1962	67	279.2	220.0	268.1	56.8	276.8
1963	72	300.0	236.4	272.9	57.9	294.3
1964	80	333.3	262.6	279.6	59.3	321.9
1965	90	375.0	295.5	284.9	60.4	355.9
1966	100	416.7	328.4	293.1	62.1	390.5
1967	111	462.5	364.5	302.2	64.1	428.6
1968	120	500.0	394.0	313.7	66.5	460.5
1969	122	508.3	400.5	324.1	68.7	469.2

[1] Taken from unpublished data on land values, Dominion Bureau of Statistics, Agriculture Division.

[2] Weights derived from *1966 Census of Canada* data, value of land $13,150 million; value of machinery $3,549 million, respectively 78.8 per cent and 21.2 per cent.

[3] Table A.8.

Appendix B

ECONOMIES OF SCALE IN CANADIAN FARMING

This appendix presents some evidence with respect to economies of scale in Canadian farming. It covers wheat farms, cash grain farm (grains other than wheat), milk farms, cattle farms, and hog farms in various parts of Canada. Farms have been classified by type on the basis of receiving 50 per cent or more of their sales revenue from one of those categories. The data used were those obtained by the Dominion Bureau of Statistics in its 1958 *Farm Income and Expenditure Survey.* The data satisfied many of the requirements of a good statistical analysis of economies of scale. The sample was large; it included farms ranging from very small to very large, and farms were chosen to give the correct proportional representation to farms of different sizes. Table B.1 summarizes the sample size for each of the relationships that were analyzed.

Economies of scale were analyzed by relating total cost and total machinery cost to gross income and total acreage for a number of different types of farming in different areas of Canada. For purposes of this analysis the following definitions were adopted. Gross Income includes sales of products and services, net change in inventory of crops and livestock, value of income in kind, supplementary payments and custom work. Total Cost, excluding rent and interest paid, includes an estimated 5 per cent return on the value of farm real estate (excluding the farm house and farm buildings rented to others), farm machinery, and livestock. It includes an allowance for the operator's own labour and unpaid family labour, estimated at $40 per week for the number of weeks worked. These adjustments remove the effects that would be introduced by different tenure arrangements, amounts of indebtedness and degrees of family labour use.

An allowance for depreciation was included at 4 per cent for farm buildings; 10 per cent for tractors, self-propelled combines, trucks, and the farm share of the passenger automobile; and 7 per cent for other types of machinery. Fixed costs such as taxes, licence fees and insurance, and all other operating expenses, were also included.

Machinery Cost includes a return on the capital value of the machinery on the farm estimated at 5 per cent and depreciation estimated as above. Licence fees,

TABLE B.1 – NUMBER OF FARMS BY RELATIONSHIPS ANALYZED AND BY AREA, CANADA, 1958

Type of Farm and Location	Cost-Gross Income	Cost-Acres	Machinery Cost-Gross Income	Machinery Cost-Acres
Wheat				
Manitoba	140	140	140	140
Saskatchewan	653	653	653	653
Alberta	158	158	158	158
Cash Grain				
Ontario	79	–	79	79
Manitoba	196	–	196	196
Saskatchewan	–	–	262	262
Alberta	171	–	171	171
Milk				
Nova Scotia	41	–	41	–
Quebec	315	–	315	–
Ontario	310	–	310	–
British Columbia	91	–	91	–
Cattle				
Ontario	294	–	294	–
Manitoba	100	–	100	–
Saskatchewan	92	–	92	–
Alberta	201	–	201	–
British Columbia	84	–	84	–
Hogs				
Quebec	65	–	–	–
Ontario	95	–	–	–
Alberta	127	–	–	–

registration costs, insurance, fuel, repairs, and other machine operating costs are also included.

Linear and non-linear hypotheses about the cost-scale relationship were tested by including first-, second-, and third-degree terms in gross income, or improved acres. The first-degree term captures a linear relationship, while the second- and third-degree terms capture a non-linear relationship. Thus we may write

$$Y = a + bX + cX^2 + dX^3 + U$$

where Y is gross income or improved cost,

X is gross income or improved acres, and

U reflects the influence of the random factors, which may be large in agriculture, as it is a biological industry.

Stepwise, least-squares regression method was used. It relates the influence of one variable at a time to the dependent variable.

Table B.2 presents the regression equations obtained from this analysis and the coefficients of determination for different types of farms in various locations in Canada. Average cost relationships derived from these regression equations are presented for a number of farm types and locations in Figures B.1 to B.5.

In nearly all cases the relations between total cost and total machinery cost on the one hand and total output or total acreage on the other is linear or almost linear. Where a quadratic or cubic term appears it is invariably very small. Where total cost is regressed against both gross income and total improved acreage the former regression in most instances provides a higher coefficient of determination. The same is true with respect to total machinery cost.

As is evident in Figure B.1 the average cost curves derived from the total cost functions fall rapidly at first and then tend to approach a horizontal straight line. This indicates that as the average farm size increases, average costs fall rapidly at first, but beyond a certain size, average costs change very little with increased size. For wheat farms in Saskatchewan in 1958, the data show little decline in costs per unit of output for increases in farm size beyond an annual income of $10,000. A similar kind of relationship appears to hold for total machinery cost in relation to farm size measured in gross income. This general pattern was fairly similar for each of the farm types analyzed. However, machinery costs were a much less important component of cost in the case of farms whose major crop was livestock or livestock products.

TABLE B.2–REGRESSION RESULTS, TOTAL COST, AND TOTAL MACHINERY FUNCTIONS

	Y	a	bX	cX^2	dX^3	R^2
Wheat Farms		$Y = (a, bX, cX^2, dX^3)$				
T.C. – Output						
Manitoba	$Y =$	1,690.44	1.311 (0.203)[1]	-0.000069 (0.000019)[1]	0.000000000000098 (0.000000000000028)[1]	0.661
Saskatchewan	$Y =$	3,285.11	0.629 (0.0185)[1]			0.640
Alberta	$Y =$	2,772.80	0.709 (0.0314)[1]			0.765
T.M.C. – Output						
Manitoba	$Y =$	792.10	0.229 (0.0149)[1]			0.632
Saskatchewan	$Y =$	1,089.92	0.217 (0.0084)[1]			0.510
Alberta	$Y =$	1,013.33	0.178 (0.0258)[1]	0.0000027 (0.00000069)[1]		0.775
T.C. – Acres						
Manitoba	$Y =$	2,293.80	12.055 (0.840)[1]			0.599
Saskatchewan	$Y =$	3,287.04	5.849 (0.724)[1]	0.0013 (0.00039)[1]	-0.000000000075 (0.000000000011)[1]	0.576
Alberta	$Y =$	1,939.57	12.557 (1.2999)[1]	-0.00196 (0.00042)[1]	0.000000000086 (0.000000000000047)	0.570
T.M.C. – Acres						
Manitoba	$Y =$	447.72	4.726 (0.280)[1]			0.675
Saskatchewan	$Y =$	932.13	2.145 (0.341)[1]	0.00089 (0.00024)[1]	-0.00000022 (0.000000039)	0.570
Alberta	$Y =$	301.47	4.942 (0.6029)[1]	-0.00094 (0.00026)[1]	0.000000046 (0.000000026)[2]	0.530

Cash Grain Farms						
T.C. – Output						
Ontario	$Y =$	1,534.59	1.095 (0.1986)[1]	-0.0000297 (0.0000148)[2]	0.0000000036 (0.000000000175)[2]	0.903
Manitoba	$Y =$	2,450.71	1.140 (0.274)[1]	-0.000074 (0.000032)[2]	0.0000000025 (0.0000000010)[2]	0.482
Alberta	$Y =$	2,340.32	0.929 (0.080)[2]	-0.000022 (0.0000045)	0.0000000003 (0.000000000054)	0.879
T.M.C. – Output						
Ontario	$Y =$	592.22	0.202 (0.0275)[1]	-0.00000092 (0.00000043)[2]		0.703
Manitoba	$Y =$	968.85	0.186 (0.0149)[1]			0.440
Saskatchewan	$Y =$	182.16	0.511 (0.039)[1]	-0.000023 (0.0000024)[1]	0.000000000000016 (0.0000000000000011)[1]	0.818
Alberta	$Y =$	1,092.29	0.188 (0.010)[1]			0.676
T.M.C. – Acres						
Ontario	$Y =$	209.03	15.191 (1.413)[1]			0.600
Manitoba	$Y =$	505.42	4.757 (0.2635)[1]			0.627
Saskatchewan	$Y =$	97.11	5.000 (0.2677)[1]		-0.00000011 (0.000000009)	0.592
Alberta	$Y =$	555.25	4.910 (0.348)[1]		-0.00000013 (0.000000011)[1]	0.544

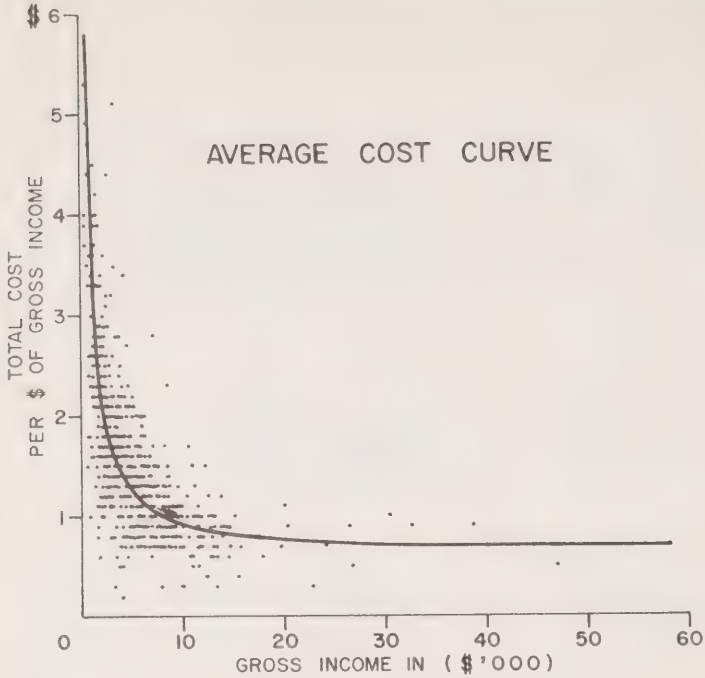
TABLE B.2–REGRESSION RESULTS, TOTAL COST, AND TOTAL MACHINERY FUNCTIONS–*Continued*

	Y	a	bX	cX^2	dX^3	R^2
Milk Farms		$Y = (a, bX, cX^2, dX^3)$				
T.C. – Output						
Nova Scotia	$Y =$	3,159.51	0.643 (0.0798)[1]			0.625
Quebec	$Y =$	3,600.66	0.474 (0.137)[1]	0.00004 (0.00001)[1]	-0.0000000001 (0.0000000002)[1]	0.691
Ontario	$Y =$	1,476.67	1.210 (0.099)[1]	-0.00003 (0.000005)[1]	0.0000000005 (0.00000000007)[1]	0.868
B.C.	$Y =$	4,038.00	0.400 (0.156)[2]	0.00002 (0.000006)[1]	-0.0000000003 (0.00000000006)	0.867
T.M.C. – Output						
Nova Scotia	$Y =$	424.99	0.110 (0.0231)[1]			0.370
Quebec	$Y =$	281.73	0.111 (0.028)[1]	0.000008 (0.000002)[1]	-0.0000000002 (0.00000000003)[1]	0.660
Ontario	$Y =$	35.76	0.267 (0.0255)[1]	-0.0000086 (0.0000014)[1]	0.0000000001 (0.00000000002)[1]	0.731
B.C.	$Y =$	299.48	0.249 (0.388)[1]	-0.000007 (0.000002)[1]	0.00000000008 (0.00000000002)	0.837
Cattle Farms						
T.C. – Output						
Ontario	$Y =$	2,447.61	0.915 (0.0392)[1]	0.0000024 (0.0000078)[1]		0.917
Manitoba	$Y =$	2,147.59	0.996 (0.0599)[1]		-0.0000000001 (0.00000000005)	0.887
Saskatchewan	$Y =$	4,005.31	0.717 (0.047)[1]			0.721
Alberta	$Y =$	3,658.86	0.697 (0.0219)[1]			0.836
B.C.	$Y =$	2,118.83	0.736 (0.0699)[1]			0.575

T.M.C. – Output						
Ontario	$Y =$	545.76	0.098 (0.007)[1]		-0.0000000000076 (0.0000000000022)[1]	0.495
Manitoba	$Y =$	43.02	0.375 (0.030)[1]	-0.000007 (0.00000096)[1]		0.710
Saskatchewan	$Y =$	771.96	0.228 (0.0145)[1]			0.732
Alberta	$Y =$	650.36	0.226 (0.0339)[1]	-0.000005 (0.0000012)[1]	0.000000000045 (0.000000000010)[1]	0.568
B.C.	$Y =$	190.82	0.189 (0.031)[1]		-0.000000000064 (0.000000000030)[1]	0.513
Hog Farms						
T.C. – Output						
Quebec	$Y =$	242.34	1.591 (0.265)[1]	-0.000047 (0.000019)[2]	0.00000000088 (0.00000000034)[2]	0.886
Ontario	$Y =$	2,939.78	0.680 (0.0998)[1]	0.000011 (0.000004)[2]	-0.000000000099 (0.000000000032)[1]	0.957
Alberta	$Y =$	5,055.94		0.00007 (0.00001)[1]	-0.0000000014 (0.00000000043)[1]	0.712

T.C. – total cost.
T.M.C – total machinery cost.
Y – regression values, estimated total cost or estimated total machinery cost, dollars.
X – gross income in dollars or improved acres.
Note: Values in parentheses are standard errors.
[1]Significant at 1 per cent level.
[2]Significant at 5 per cent level.

FIGURE B.1—SASKATCHEWAN WHEAT FARMS



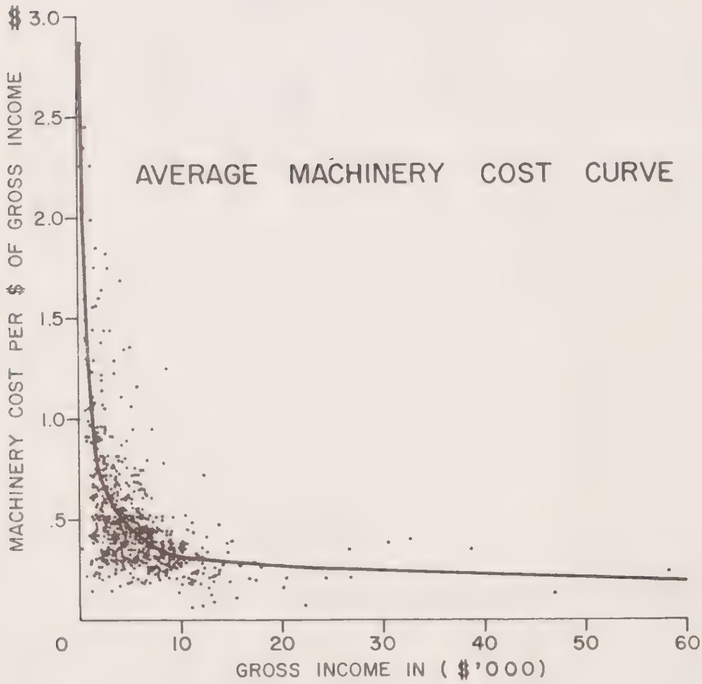


FIGURE B.2–SASKATCHEWAN WHEAT FARMS (IMPROVED ACRES)

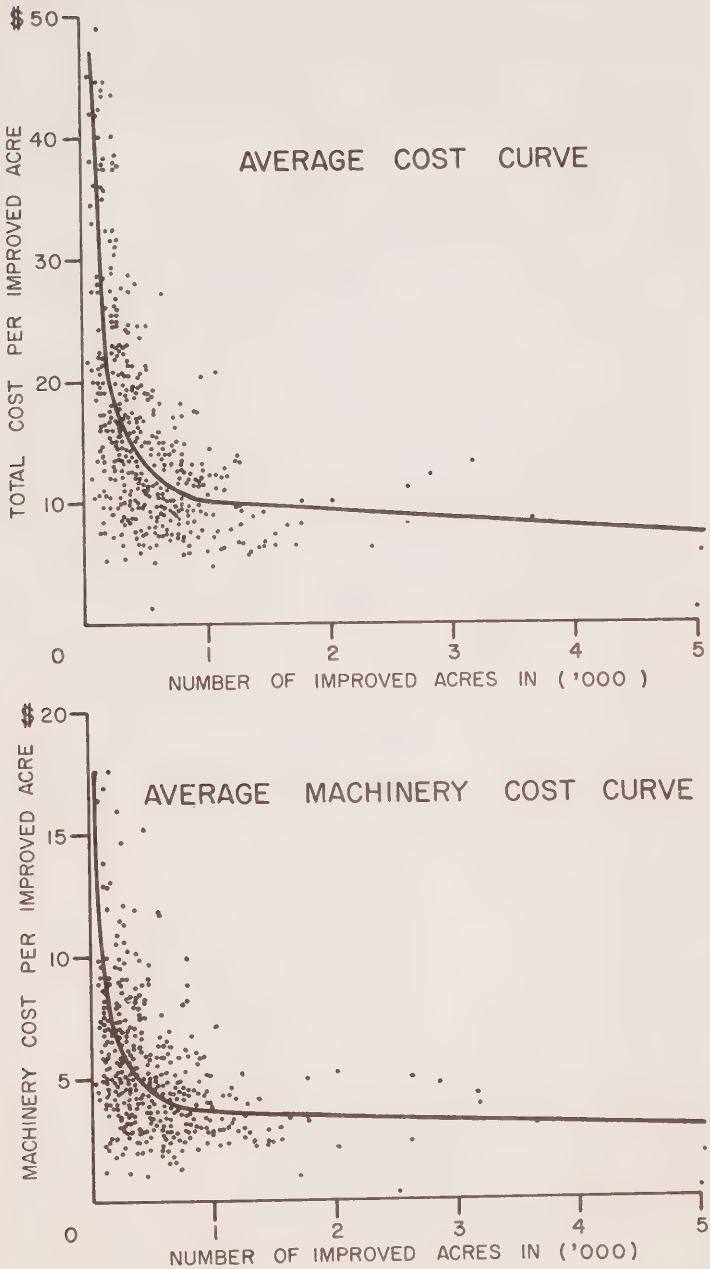
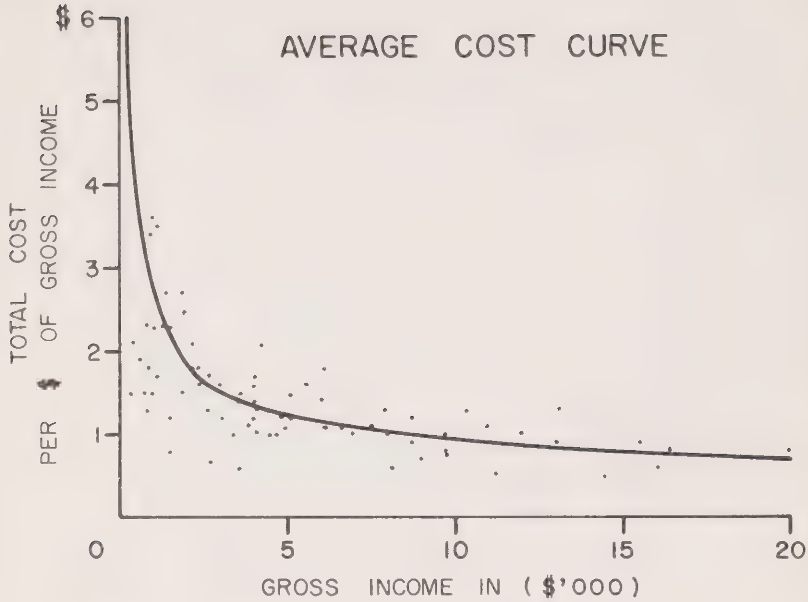


FIGURE B.3—ONTARIO CASH GRAIN FARMS



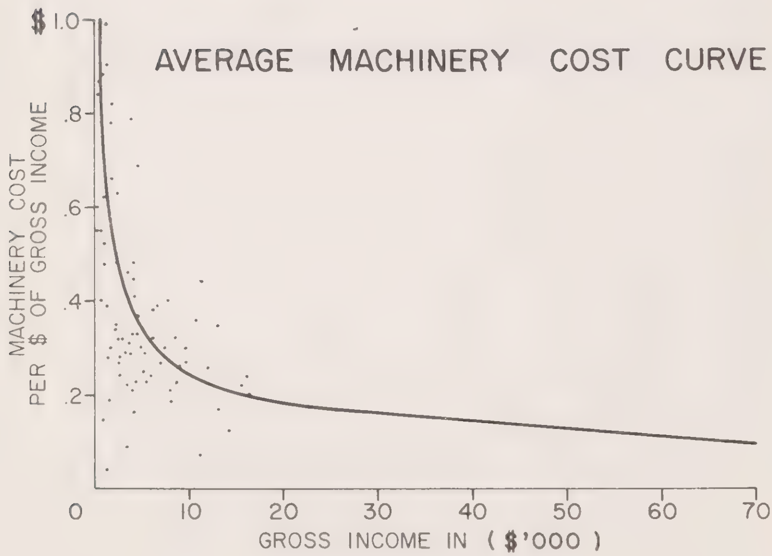
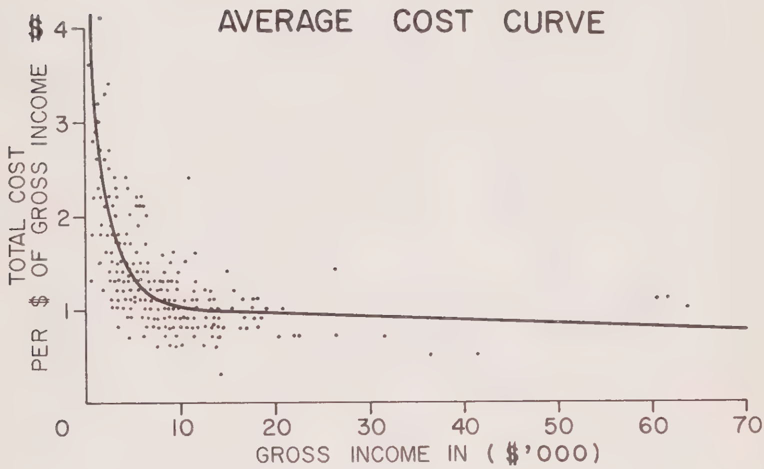


FIGURE B.4—ONTARIO MILK FARMS



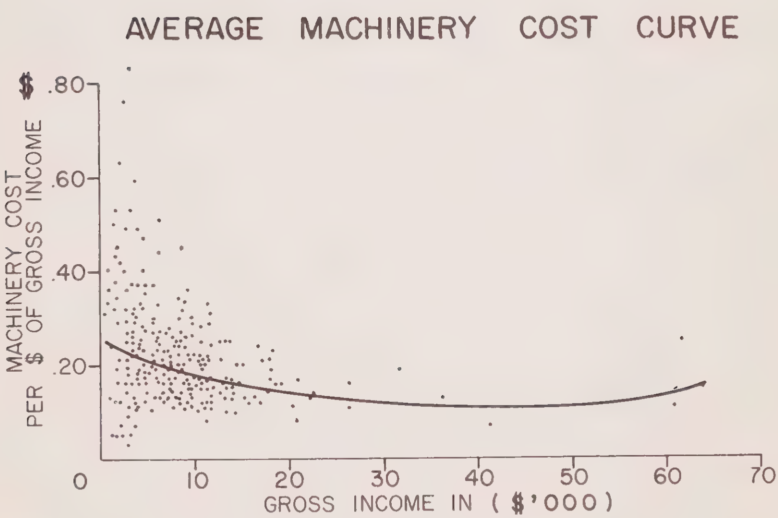
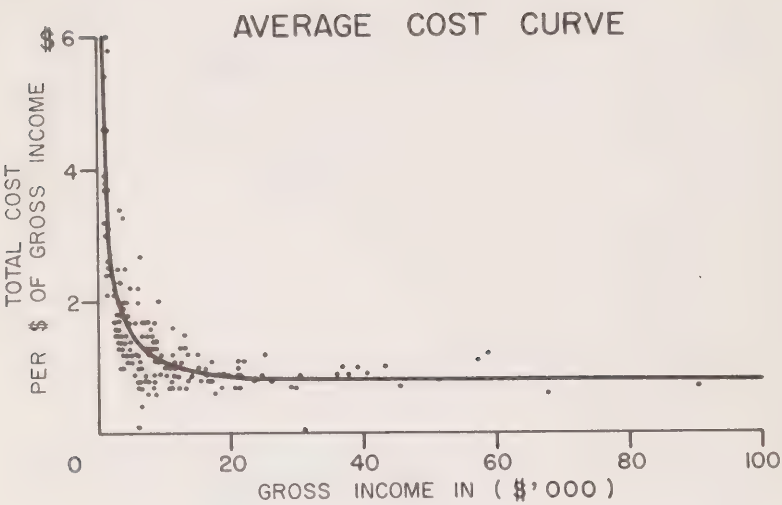
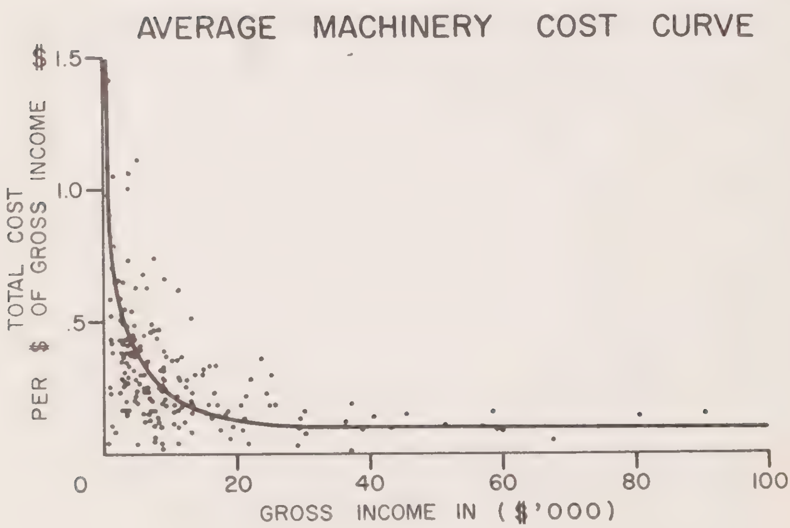


FIGURE B.5 – ALBERTA CATTLE FARMS





Appendix C

PRESENTATIONS AND SUBMISSIONS MADE TO THE ROYAL COMMISSION ON FARM MACHINERY AT PUBLIC HEARINGS

* **Oral presentation only**
‡ **Partly or wholly in-camera**

WINNIPEG

March 6 and 7, 1967

Government of Manitoba
Manitoba Farm Bureau
Manitoba Farmers' Union
Western Manitoba Farm Business Association

EDMONTON

March 13-15, 1967

Alberta Department of Agriculture
Professor F. V. MacHardy, Private Brief
Professor H. P. Harrison, Private Brief
Professor T. A. Preston, Private Brief
Alberta Federation of Agriculture
Farmers' Union of Alberta

CALGARY

March 16 and 17, 1967

Robin-Nodwell Mfg. Ltd.
United Farmers of Alberta Co-operative Ltd.
Alberta Wheat Pool
Alberta Retail Implement Dealers' Association
Mr. M. H. C. Ford, Private Brief
Mr. J. C. Rogers, Private Brief

VICTORIA

March 20, 1967

Government of British Columbia, Department of Agriculture
British Columbia Federation of Agriculture

VANCOUVER

March 21, 1967

Mr. W. Pekonen, Private Brief
Farmers' Union of British Columbia

REGINA

March 28 and 29, 1967

Government of Saskatchewan, Department of Agriculture
Mr. J. R. Knelsen, Private Brief
Mr. D. L. Trapp, Private Brief
Saskatchewan Federation of Agriculture
Saskatchewan Wheat Pool

SASKATOON

March 30, 1967

Saskatchewan Farmers Union
Saskatchewan Implement Dealers Association
Mr. L. Kolbinson, Private Brief
Professor O. L. Symes, Private Brief

FREDERICTON

April 3, 1967

Province of New Brunswick
New Brunswick Federation of Agriculture

CHARLOTTETOWN

April 5, 1967

The P.E.I. Federation of Agriculture

HALIFAX

April 7, 1967

Nova Scotia Department of Agriculture and Marketing
The Nova Scotia Federation of Agriculture, Farm Machinery Committee
Scotian Gold Co-operative Limited, Machine Shop Division

ST. JOHN'S

April 10, 1967

The Newfoundland Co-operative Union and The Newfoundland
Producers Co-operative Society, Combined Brief

QUEBEC CITY

April 17, 1967

Professor J.-M. Fortin

MONTREAL

April 19, 1967

Mr. Alfred G. Morrison

REGINA

October 12 and 13, 1967

The Saskatchewan Association of Rural Municipalities and The Agricultural Economics Department of the University of Saskatchewan
The Canadian Federation of Farm Equipment Dealers
Mr. Fred J. Schneider, Private Brief
Western Manitoba Farm Business Association
Communist Party of Canada, Central Committee

OTTAWA

October 23 and 24, 1967

J. I. Case Company
John Deere Limited‡

TORONTO

October 30-November 2, 1967

Ontario Farm Machinery Advisory Board, representing the Ontario Department of Agriculture and Food and the Province of Ontario
The Ontario Federation of Agriculture
Ontario Farmers' Union
Cosmos Imperial Mills Limited
George White & Sons Co. Limited
Mr. Alan M. Heisy, Private Brief

OTTAWA

November 13-16, December 11-14, 1967, and January 8-10, 15, 16, 18, and 19, 1968

Cockshutt Farm Equipment of Canada Limited
Minneapolis-Moline of Canada, Ltd.
New Holland Division of Sperry Rand Corporation‡
Ford Motor Company of Canada, Limited, Tractor and Equipment Operations‡
International Harvester Company of Canada, Limited‡
The Canadian Co-operative Implements Ltd.

Holiday Farm - Machinery Testing, Rental and Repair Service
Allis-Chalmers, Rumely, Ltd.
Massey-Ferguson Industries Limited
The National Committee on Agricultural Engineering
Canadian Labour Congress
National Farmers Union
The Canadian Federation of Agriculture
Avco New Idea Farm Equipment*‡
Farm Equipment Manufacturers Association

Appendix D

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